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JAPAN REPORT

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MILITARY

OUTLINE OF FY 1980 - 84 MEDIUM-TERM DEFENSE PROGRAM

Tokyo JPE AVIATION REPORT-WEEKLY in English 21 May 80 pp 4-8

[Text]

Different from the previous four defense buildup programs which were approved by the National Defense Council (NDC), Japan's highest decision making body on national defense policy, prior to execution by the Japanese Defense Agency (JDA), the FY 1980 - 84 Medium-Term Defense Program (MTDP) is regarded as "guidance data for JDA's internal use only" and has neither been discussed nor approved by the NDC. The JDA, however, prepares its annual budget requests for the period mentioned above, based on the MTDP. The following is a brief outline of the military buildup program which was published by the JDA last week:

Organization and Deployment

1. The GSDF's 7th Division headquartered at Higashi-Chitose will be reorganized into an armored division, by placing the 1st Tank Group under its command. The reorganization will be completed in FY '80.

2. A second mixed brigade consisting of an infantry regiment, artillery, tank and engineering battalions with a complement of about 2,100 personnel will be established in Shikoku, by reorganizing the 13th Div.

3. The MSDF Okinawa Air Unit will be reorganized and become 5th MSDF Air Wing in FY '80. The wing will consist of 610 personnel and be equipped with 11 P2Js.

4. An ASDF airborne early warning squadron initially consisting of about 300 personnel and four Grumman E-2Cs will be organized in FY '83. Four more aircraft will be added later. It will be deployed in northern Japan.

5. The MSDF will establish the 6th (P-3C) Air Sq. in FY '82, the 122nd (shipborne HSS-2) Sq. in FY '80, the 1st Submarine Flotilla in FY '80 and the 37th Escort Flotilla (regional antisubmarine force) in FY '81.

6. The ASDF will establish 202nd, 203rd and 204th (F-15) Sqs. during the period FY '82 - '84, the 306th (F-4EJ) Sq. in FY '81 and the 6th (F-1) Sq. in FY '80.

Command Control and Communications

1. A final decision on a BADGE modernization program will be made around FY '81.

2. Capabilities of the GSDF coastal surveillance force and MSDF surveillance units at Tsushima, Tsugaru and Soya will be improved. The ASDF will also upgrade its air warning and control capabilities.

3. A tri-service central command system will be established so operations of the three Self-Defense Forces will be coordinated and controlled.

4. Construction of defense microwave networks will continue in the Chugoku, Shikoku and Kyushu areas in and after FY '80. The JDA completed the Takahatayama - Kanoya line in FY '77, the Ichigaya - Misawa/Hachinoe and - Fuchu lines in FY '78, the Misawa - Sapporo and the Ichigaya - Itami lines in FY '79. The Sapporo - Asahikawa line is presently under construction. Automatic telephone networks among all SDF units will be completed during the MTDP. In addition, the MSDF will set up an ultralong wave transmission station for submarines and marine satellite communications systems. The ASDF will construct multichannel and over-the-horizon communications networks for its air warning and air control units.

Equipment

GSDF

1. Three hundred and one Model 74 tanks will be procured so that the total GSDF main battle tanks will reach 1,030 at the end of the MTDP. Approximately half of the tanks will be Model 74s.

2. About 140 155mm and about 40 203mm self-propelled howitzers will be procured and deployed mainly under the command of the Northern Army.

3. About 40 Model 73 APCs and about 70 new wheeled-type APCs will be procured.

4. Antiship/antitank guided missile launchers, 84mm recoilless rifles and grenade launching rifles will be procured to reinforce antitank force.

5. Based on evaluation tests of two AH-1S helicopters funded in FY '77 and FY '78, the GSDF will decide on a future antitank helicopter program.

6. Two conventional Hawk units will be reequipped with the Improved Hawk missile. The Hawk improvement program started in FY '77 and 4.5 units will be reequipped with the Improved Hawk by the end of the MTDP.

7. A decision will be made on replacement of the GSDF Hawk (and the ASDF Nike).

MSDF

1. Thirty-nine ships totaling 70,160 displacement tons will be constructed. At the end of the MTDP, the MSDF will have 161 ships, displacing 264,112 tons.

2. Two DDGs, ten DDs and four DEs will be constructed. Four DDAs and two DDHs now in service will enter the fleet rehabilitation and modernization (FRAM) program. The DDG and the DD will be equipped with Tartar and Sea Sparrow missiles in addition to advanced antisubmarine equipment. The DE will be armed with the Harpoon missile. The ships which will be subject to the FRAM program will also be equipped with such guided weapons as the Sea Sparrow and the Harpoon. At the end of the MTDP, the MSDF will have 58 antisubmarine warships, of which 35 will be equipped with guided weapons.

3. The MSDF will construct five 2,200-ton submarines in order to supplement or replace those now in service. The new submarines will be equipped with the Harpoon. At the end of the MTDP, the MSDF will have 14 submarines, displacing 29,050 tons.

4. In addition to the above vessels, 11 440-ton mine-sweepers, one 3,600-ton submarine tender, two 1,100-ton marine survey ships and one 5,000-ton supply ship will be constructed.

5. Sixty-one fixed wing aircraft including 37 P-3Cs and 73 helicopters will be procured. The helicopters will include 25 land-based HSS-2Bs, 26 shipborne HSS-2Bs, two new aircraft of the SH-60 class which will replace the shipborne HSS-2B in the future and six new mine-sweeping helicopters of the RH-53E class.

ASDF

1. Ninety-four front-line aircraft including 77 F-15s will be procured. Including the 23 aircraft funded in FY '78, the ASDF will have 100 F-15s in its inventory. These F-15s will replace four squadrons of F-104s which will be phased out. The ASDF interceptor force will then consist of F-15 and F-4EJ aircraft. In order to maintain ten interceptor squadrons, the ASDF will consider purchase of additional interceptor aircraft, depending on attrition losses of F-4EJs.

2. Other than the F-15s, 13 F-1 support fighters, four E-2C early warning aircraft and 23 T-2 advanced trainers will be purchased.(The ASDF will have eight Grumman aircraft for two-point patrol duties.)

3. To supplement or replace the Kawasaki C-1 transport, the ASDF will select a new aircraft (C-X) which can meet its future requirements. The ASDF has 24 C-1s in its air transport inventory although it is authorized 36 aircraft.

4. For air defense of the Keihanshin (Kyoto-Osaka-Kobe) area, one Nike squadron will be deployed. The ASDF will then have six Nike groups consisting of 20 squadrons.

5. A decision will be made on replacement of the ASDF Nike (and the GSDF Hawk).

Other Issues Related With the SDF

Efforts will be made to increase stockpiling of ammunition by the SDF. The MSDF will improve its torpedo and mine maintenance and service facilities.

Base Air Defense

1. For air defense of bases and radar sites in northern Japan, the ASDF will procure 12 Tan-SAMs, 120 portable SAMs and 53 antiaircraft machine guns. It will also procure 36 fixed- and 10 mobile-type aircraft shelters as well as 39 sets of damaged runway repair mats.

2. The MSDF will procure 68 portable SAMs to defend air and ship bases in northern Japan.

CSO: 4120

MILITARY

DEFENSE CHIEF ISSUES INSTRUCTION ON FY '81 R&D PROGRAMS

Tokyo JPE AVIATION-REPORT WEEKLY in English 21 May 80 pp 8, 9

[Text]

Kichizo Hosoda, State Minister for Defense, last week gave Yukie Omori, Director-General, Technical R&D Institute (TR&DI), JDA, official instruction on drafting military R&D programs for FY 1981 (April 1981-March 1982). The order put emphasis on such new weapons systems as long-range torpedoes, mechanized infantry combat vehicles (MICV), improvement of electronic warfare capability, and cooperation with the United States in equipment procurement.

Details of the instruction follow:

1. Technical development for actual procurement for the Self-Defense Forces (SDF):

1) Long-range torpedoes to be launched from submarines to home on enemy submarines and surface ships at high speed. Performance, although secret, is designed to outperform that of the US Navy's MK-48 with a speed of 50 knots and a range of 46 kilometers. Several of the new long-range torpedoes will be tested in FY 1980. They will enter service in three to four years.

2) Field surveillance radar to be used by the GSDF for detecting mobile targets at a range of 30 kilometers.

3) Anti-mortar radar to detect enemy mortars.

4) Improvement of electronic countermeasure (ECM) capability with emphasis on development of jamming and antijamming systems. Japan has to develop ECM systems on its own, as the United States is reluctant to release data.

2. Reseach on technical possibilities and fabricating parts:

1) MICV with combat troops and weapons aboard. Weapons will include 30mm machine guns and antitank missiles. In FY 1981, bodies and tracks will be fabricated for complete development in the future.

2) New main battle tanks (MBT) will become a subject for technical development in FY 1982.

3. Other items:

1) Adjustment of equipment under research to standards common to the SDF and US forces. For example, a 120mm smoothbore gun, the main weapon of the US XM-1 tank now under development, will be adopted for the new MBT.

2) Promotion of technical exchanges with the United States under the 1962 bilateral arrangement for exchange of data. US data to be obtained in FY 1981 will include US Defense Department information about CCV aircraft, which TR&DI plans to fabricate by modifying domestically-produced supersonic trainers in order to develop new fighter aircraft.

3) Improvement of facilities for developing electronic warfare capability.

CSO: 4120

MILITARY

FUTURE OF PS-1 FLYING BOAT BLEAK

Tokyo JPE AVIATION REPORT-WEEKLY in English 21 May 80 p 10

[Text]

With scheduled service introduction of the Lockheed P-3C in FY 1982, the MSDF must decide whether it will continue to operate a squadron of the PS-1 antisubmarine flyingboat into the late '80s or phase it out for a land-based ASW aircraft squadron. The MSDF completed a combat performance evaluation program on the aircraft at the end of March and a final report from the Commander-in-Chief, Self-Defense Fleet is due to be submitted soon to the Chief of Staff, Maritime Self-Defense Force. At present 19 PS-1s are in service with the 31st MSDF Fleet Air Wing based at Iwakuni.

In this connection, what Adm. Tsugio Yada, Chief of Staff, MSDF, told a recent press conference indicates that the future of the PS-1 squadron is not bright. According to Yada, there is something still desired in the PS-1's performance, compared with newer ASW aircraft. He added, however, that this does not mean the PS-1 is obsolete. He hinted he will consider the special operational advantages of the flyingboat over land-based aircraft in making a final decision.

CSO: 4120

MILITARY

AIRCRAFT STRENGTH IN FY 1984 STILL BELOW AUTHORIZED LEVELS

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 5, 6

[Text]

Even if the FY '80-'84 Medium-Term Defense Program (MTDP) is fully realized, aircraft strength of the ASDF and the MSDF in FY 1984 will be below levels authorized by the government in 1976. This was revealed in explanatory notes of the Japanese Defense Agency submitted recently to the House of Representatives National Security Special Committee. ASDF strength will fall 90 aircraft short and the MSDF strength 40, resepectively, of the targeted operational aircraft strength in FY 1984.

The MSDF is authorized to maintain a total of 16 squadrons including 10 large fixed-wing aircraft squadrons and six land-based helicopter squadrons. In number of aircraft, the MSDF air arm will comprise 100 large fixed-wing aircraft, 55 land-based helicopters, 50 shipborne helicopters, and 15 mine-sweeping helicopters, a total of 220 aircraft. In FY 1984, however, MSDF air strength will only total 180 aircraft due to a deficit of 10 aircraft in each of the four categories. Consequently, there will be only 14 operational squadrons in FY 1984 comprising nine fixed-wing squadrons and five land-based helicopter squadrons.

The nine fixed-wing squadrons will include one squadron of the PS-1 flyingboat, the rest currently using P2V-7s and P-2Js. Forty-five P-3Cs are scheduled to replace P2V-7s and P-2Js to form eight squadrons eventually, while there is no plan to procure replacements for S2Fs which comprise two squadrons.

The MSDF plans to replace HSS-1 and HSS-2A helicopters in land-based squadrons during the FY '80-'84 MTDP. However, priority is being given on assigning HSS-2Bs to new destroyers. Accordingly, it is planned that only five land-based helicopter squadrons will be deployed in FY 1984. Of the shipborne helicopters, 12 are planned to be of a new type. During the MTDP however only two units will be purchased. Present mine-sweeping helicopters are being phased out, but only six aircraft will be procured with 10 left for purchase under the next MTDP.

The ASDF is authorized to maintain 250 fighter interceptors, 100 support fighters, 30 reconnaissance aircraft, 40 transports, and 10 aerial early warning aircraft. However, only 336 aircraft will be in service with the ASDF in FY 1984. ASDF operational aircraft strength in that year will comprise 221 fighter interceptors, 63 support fighters, 13 reconnaissance aircraft, 31 transports, and eight AEW aircraft. The ASDF plans to build up to authorized strength through procurement programs under the following MTDP.

As to the fighter interceptors, procurement of 100 F-15s is under way to establish four squadrons and further F-15 procurement will be required. A support fighter squadron was originally planned to have 25 aircraft. Today's F-1 squadrons however have only 18 aircraft. Strenghtening of support fighter squadrons beyond the present MTDP will be achieved by purchasing a new type of aircraft. The reconnaissance squadron, originally planned to have 24 aircraft, has only 14 at present. There is no plan, however, to reinforce this squadron currently equipped with RF-4Es. As to transport strength, the ASDF is authorized to maintain 24 C-1s. The balance will be met with procurement of a new aircraft, possibly a long-range transport.

CSO: 4120

MILITARY

ASDF TO STUDY NEW BADGE AIR DEFENSE SYSTEM

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 6, 7

[Text]

The ASDF will study what could be the new BADGE air defense system in FY 1980, following joint consideration of problems regarding the current BADGE system with representatives from the USAF and Mitre Corp., an American systems consultant. The study will also be assigned to a consulting team of the USAF and Mitre and ASDF and Japanese manufacturers concerned will take part.

In FY 1981, a specific concept for the new BADGE system will be drafted by the ASDF and Japanese makers. The BADGE system project will thus remain in the software stage until FY 1981.

After basic design begins in the latter half of FY 1981, the project will shift to the hardware stage in FY 1982 with detailed design and fabrication of equipment starting.

Equipment will be completed gradually from the end of FY 1983 for installation and tests in FY 1984. Testing is expected to be completed in FY 1985.

The current BADGE system became operational in FY 1968 after completion in FY 1967 and was upgraded from FY 1975 to 1977. Around FY 1985 the current system will be replaced by the new system.

The existing system was manufactured under American license. However, the ASDF intends to domestically-produced hardware and only introduce software from abroad.

CSO: 4120

ASDF F-15 PILOT TRAINING PROGRAM

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 p 7

[Text]

The ASDF plans to send three pilots to the US around July this year to begin training its F-15 fighter pilots. The three will receive training using the first two ASDF F-15 aircraft built in the US. Next spring, they will return to Japan prior to arrival of the ASDF F-15s, to prepare for operational tests in Japan.

Toward the end of FY 1980 (March 31, 1981), a second group of 14 pilots will be sent to the US for training throughout FY 1981. They will become instructor pilots and four of the 14 will compile an F-15 training syllabus before the summer of 1982.

Pilots to receive training in the US will be selected from veteran F-104J and F-4EJ pilots. Ten pilots will be assigned to the first F-15 squadron to be activated at the ASDF Nyutabaru air base in FY 1982.

Seventy maintenance crews have completed training in the US and returned to Japan last March. Later this year they will start training F-15 maintenance crews at the ASDF First Technical School. Training will cover ten specialities---engine, fuselage maintenance, fuselage repair, ammunition, hydraulics, airborne navigation system, fire control system, airborne radio system, measuring instruments, and other electrical equipment.

CSO: 4120

MILITARY

ASDF TO REQUEST SIX C-X TRANSPORTS, TWO HELICOPTERS IN FY '81

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 p 8

[Text]

The Air Self-Defense Force (ASDF) is expected to request authorization for six C-X tactical transport aircraft and two transport helicopters in FY 1981 starting in April 1981.

It hopes to begin the C-X and transport helicopter procurement projects next fiscal year, and is considering incorporating the six C-X transports and two helicopters as the start of its FY 1981 aircraft procurement program. This will form part of its operations plans now under preparation on the basis of State Minister for Defense Kichizo Hosoda's instruction late in April.

The ASDF has drafted plans to expand its current 24-plane C-1 fleet for main transport missions to a 36-plane setup and inaugurate a transport helicopter fleet since the Defense Agency's FY 1980-84 Medium-Term Defense Program, drafted in July 1979, recommended it take such measures after reviewing the current air transport setup.

It plans to adopt new C-X transports for enlarging the transport fleet because the current C-1s involve problems regarding price and capacity. The C-130 is mentioned as a promising candidate for the C-X. The ASDF is likely to procure a total of 14 to 16 C-X aircraft, including reserves. Following the expected funds for six aircraft in FY 1981, it may request funds for the same number in FY 1983 and two or three for reserves in FY 1985.

On the transport helicopter project, the ASDF intends to assign two helicopters to each of the Northern, Central and Western Commands and the Southwest Air Group. Therefore, the total is likely to be 10 or 12 aircraft, including reserves. Under this estimate, the ASDF may request two to three aircraft per year from FY 1981. A version of the V-107A now used for rescue missions will be chosen as the transport helicopter.

CSO: 4120

MILITARY

BOEING PROPOSES E-3A TO ASDF

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 8, 9

[Text]

Boeing Aerospace Co. is sending a team of specialists to the Japanese Defense Agency in June to give briefings on the E-3A Sentry Airborne Warning & Control System (AWACS) aircraft. Boeing is proposing the AWACS for operations with eight Grumman E-2C Hawkeye turboprop early warning aircraft. The ASDF will start taking delivery of the E-2Cs during FYs 1982 through 1985, and further procurement is planned. The Boeing Sentry is the world's most advanced "mother" aircraft of electronic warfare and it would upgrade the ASDF's air defense strength, Boeing says.

The E-3A is in production under a contract with the USAF for a total 34 aircraft and a contract with NATO authorities for 18. Ten Sentries are already in service with the USAF while the first aircraft for NATO will be rolled out next spring. Production will be completed in 1985.

There is no plan at the ASDF, however, to procure any AEW aircraft other than eight E-2Cs during the FY '80-'84 Medium-Term Defense Program. The Boeing E-3A will be studied by the ASDF for possible adoption under the next MTDP covering FYs '83-'87. Boeing's E-3A proposal to the ASDF is said to be the E-3SP, a special AWACS variant suitable for Japanese requirements.

CSO: 4120

MILITARY

SHORT-RANGE SAM PROCUREMENT PROSPECTS FOR GSDF, ASDF

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 9, 10

[Text]

The GSDF and the ASDF are considering starting procurement of mobile short-range antiaircraft missiles capable of defending airbases, radar sites and other important facilities and man-portable missiles for low level antiaircraft operations in FY 1981 as State Minister for Defense Kichizo Hosoda's earlier instruction on drafting the FY 1981 operations plans stipulated deployment of these surface-to-air missiles.

The GSDF desires to adopt a missile designed by the TR&DI and Toshiba as the short-range Tan-SAM. The domestically-developed missile, which will fill the gap between the L-90 machinegun and the Hawk missile, has a range of 10,000 meters, a maximum speed of Mach 2, an infrared-ray homing head and a new phased-array tracking radar.

However, the ASDF has listed the Aerospatiale/MBB Roland and the General Dynamics/Raytheon Skyguard Sparrow as candidates for its short-range SAM.

The Defense Agency thinks the GSDF and the ASDF should not necessarily adopt the same SAM. It acknowledges their unified adoption of the domestic missile would have such merits as maintenance of the domestic defense industry's technology, secured production, cost reduction by increased production, and replenishment and maintenance convenience. At the same time, it suggests the GSDF and the ASDF independently select short-range SAMs meeting their own

operational requirements in view of price, logistical supply and other aspects. It anticipates little difference between their unified and separate selection over cost and operation because a large number of short-range SAMs are expected to be required for radar site and airbase defense missions.

As for the portable SAM, the GSDF intends to select the Stinger but, the ASDF is studying the UK Army's Blowpipe as well as the Stinger.

The Stinger and Blowpipe have different tracking and guidance systems and operational systems. The agency hopes that the GSDF and the ASDF will consider not only these differences but also the two missiles' accuracy, guidance methods after launching, multitarget capability, parts supply sources, production costs and other aspects.

Meanwhile, both the GSDF and the ASDF are expected to deploy the short-range and portable SAMs mainly in Hokkaido. The ASDF's SAMs may be placed in northeastern and northern central Japan as well.

CSO: 4120

ECONOMIC

INCREASING PETRODOLLAR FLOW CITED

Tokyo KYODO in English no time given 21 May 80 OW

[Article by Hidesuke Nagashima]

[Text] Tokyo, 21 May KYODO--In the aftermath of the U.S. freeze of Iranian assets, oil-producing Arab nations have been trying to diversify their portfolio investments abroad to protect such holdings from political interventions.

Japan's securities industry has found a bonanza in the on-going diversification efforts, enjoying increased foreign investments and happily expecting an inflow of billions of dollars from the surplus OPEC funds.

The oil-producing nations, flush with surplus money in the wake of a series of oil price hikes, are expected to continue investing in Japan, though the latest political unrest in Tokyo may have temporarily tarnished Japan's image as one of the most politically stable free world nations.

The unforeseen unrest was touched off May 16 when Japan's lower house passed a nonconfidence motion against the pro-American Government of Prime Minister Masayoshi Ohira. Ohira then dissolved the house for the second general election in eight months.

But Japan's economy remains basically strong. Among the major industrial nations, the United States and Britain suffer from a combination of a recession and double-digit inflation, but Japan and West Germany still are in relatively good economic health.

Japan no doubt would be a good haven for the surplus OPEC funds, estimated at dollar 200 billion at the end of last year. It is expected to grow to dollar 100 billion this year.

The Arabs say they have a basic need to diversify their investments within a wide range of currencies and financial markets in the world to insulate international banks from politics.

Jawad Hashim, president of the Arab Monetary Fund, made that position clear recently, saying an international agreement is needed as a short-term remedy to restore international confidence in the wake of the U.S. freeze of Iranian assets.

Foreign portfolio buying of Japanese stocks--much of it evidently by the oil-producing nations--has been increasing since the middle of 1979.

Such buying exceeded selling by some yen 131 billion (dollar 570 million) in the nine-month period between last July and March.

No exact figures are available, however, on the amount of stock buying with the petro-dollar, which is made through commercial banks and investment firms in Britain and Switzerland. Oil-rich investors are generally loath to disclose their identities.

But estimates by leading securities firms put the total worth of their stock investments in Japan at dollar 1 billion and bond investments in the range of dollar 3 billion to dollar 6 billion. Additionally, dollar 7 billion is believed to have flowed into Japan as short-term funds such as deposits.

Thus the oil-producing nations are estimated to have invested more than dollar 10 billion in Japan so far.

Securities industry sources say the oil-rich investors favor high-technology stock such as electronics and precision instruments and big-capital stock like Nippon Steel.

Estimates vary as to future stock investments with the oil dollar. But the Industrial Bank of Japan, for example, estimates that they will be in the dollar 2-3 billion range in the coming six years to 1985.

On the bond markets, foreign investments have been concentrated on government bonds and convertible debentures issued by the steel and electric power industries.

Seeking more business, Japan's securities industry has been enthusiastically promoting investments by oil-producing nations.

Top executives of Japan's major securities firm have visited the Middle East and Europe--where the Arab's money managers are based--one after another for the past several months to invite more investments.

Japanese securities firms are also sending daily reports on Japan's securities markets and economy in general to the oil-rich investors.

Since last year, the big four securities firms--Nomura, Nikko, Daina and Yamaichi--have held special seminars for British commercial banks in charge of investing the Arab money worldwide.

The growing petro-dollar investments in Japan have stirred speculation about possible Arab takeovers of Japanese firms, but nothing of the sort has happened yet--not so far anyway.

Last February, a rumor swept through Kabutocho--Tokyo's Wall Street--about Kuwaitis trying to take over Maruzen Oil Co., a major Japanese oil firm.

Company officials, scoffing at the rumor, say it started after Kuwaitis had proposed to acquire some stock interest in the company, apparently to apply a leverage during oil import negotiations.

The episode is symbolic of the increasing importance of the petro-dollar to the Japanese securities market.

CSO: 4120

ECONOMIC

PRODUCTION PROGRAMS FOR F-15, P-3C

Tokyo JPE AVIATION REPORT-WEEKLY in English 21 May 80 pp 2, 3

[Text]

Specialists from the Japanese Defense Agency (JDA) will visit the US from late May through June for detailed talks with Pentagon, USAF and USN officials and related manufacturers for release of more information on the McDonnell Douglas F-15 fighter for the ASDF and the Lockheed P-3C anti-submarine patrol aircraft for the MSDF. The JDA wants to obtain such information and technical data on these aircraft so it can increase the ratio of local parts and components for Japanese Eagles and Orions in preparation for issuing the second production orders during FY 1980 to Japanese manufacturers. First orders for the F-15 and the P-3C were placed in FY 1978 which called for import of complete aircraft and knocked-down aircraft for local assembly.

For the F-15 program, E. Tsuruta, a senior staff member of the Aircraft Sec., Equipment Bureau, JDA, Lt. Col. Ryusuke Tanaka of Logistic Sec., and Maj. Masanori Ichijo of Procurement Sec., of the Air Staff Office's Logistic Div., will be visiting the US from June 2 for three weeks. During June 3 through 6, they will stay in Washington for talks with officials of the Department of Defense and the Department of Air Force.

It is expected they will try to obtain release of information on such advanced technology as the boron composite structural material for the F-15 fuselage and the hot section and components for the F100 turbofan engine. Possibilities will also be explored for authorization of local production of some software for radar equipment and the AIM-9L air-to-air missile.

The defense officials, based on the results of talks in Washington, will visit such USAF facilities as AFSC and AFLC as well as offices of US manufacturers including McDonnell Douglas, Pratt & Whitney, and Hughes Aircraft for coordination of US and Japanese efforts for local production of the F-15. The ASDF is authorized to procure 100 F-15s and the second contract for 34 aircraft is scheduled to be signed during FY 1980, following the first contract for 23 aircraft in FY 1978.

Tsuruta's itinerary is different from the two ASDF officials. After Washington, he will visit the Department of Navy and offices of five manufacturers---McDonnell Douglas, Lockheed, Pratt & Whitney, Hughes Aircraft, and Litton---to discuss various problems for smooth progress of the P-3C production program in Japan.

Prior to Tsuruta's party, Capt. Kanichiro Fukuhisa, Director, 2nd Weapons Sec., Technical Div., Maritime Staff Office, accompanied by another official, will visit the US from May 26 through June 6. Fukuhisa will visit the Naval Air Command in Washington, D.C. for talks on the P-3C production program including the tactical support center (TSC). On June 2, he will visit Sperry Univac in St. Paul, Minn., for a technical evaluation of the GSCC on order through Sumitomo Shoji in FY 1978. The GSCC is scheduled for delivery to the MSDF in June 1981. It will be shipped to Japan for installation at the MSDF Atsugi Air Station and begin operation in December 1981.

Capt. Fukuhisa will inspect Lockheed Burbank facilities on June 4 to view manufacture of eight P-3C aircraft on order through a foreign military sales contract concluded in FY 1978 and also an integrated test facility (ITF). The ITF is scheduled for delivery in October 1981 for installation at KHI's Gifu Plant for testing of P-3C avionics equipment.

CSO: 4120

C-130 PROCUREMENT PROSPECTS: IMPORT OR LICENSE PRODUCTION

Tokyo JPE AVIATION REPORT-WEEKLY in English 21 May 80 pp 3, 4

[Text]

The Ministry of International Trade and Industry (MITI) is great concerned over whether the Lockheed C-130, a promising candidate for the ASDF C-X tactical transport to be procured from FY 1981 (April 1981-March 1982), will be imported or produced locally under license, because this would have a major bearing on Japan's aircraft industry.

Lockheed has reportedly offered Japanese makers' license production of the C-130s, including aircraft for commercial use. License production, if economically feasible, would be adopted as it would contribute to maintaining operation of the aircraft industry, whose capacity is developing rapidly due to planned license production of F-15s and P-3Cs. In case of C-130 license production, new equipment investment would not be necessary for Japanese aircraft makers, sources say. Furthermore, Kawasaki Heavy Industries has already performed overhaul and repair of C-130s operated by US forces stationed in Japan.

The C-X project must undergo assessment of other government agencies than the Defense Agency because the selection of the P-3C was decided after discussions at a special committee of the National Defense Council (NDC) consisting of representatives from others concerned as well as the Defense Agency. Staff level meetings of the NDC are expected to study the C-X project.

The ASDF plans to procure 15 C-X transports over several years from FY 1981 under the year's operations plans as instructed by Kichizo Hosoda, State Minister for Defense, April 30.

In case the C-130 is selected as the C-X, the ASDF is expected to adopt the C-130H version with the Allison T56-A-15 engine. It may also consider two other Hercules versions, which Lockheed designed for USAF advanced medium short take-off and landing transports (AMST) in the summer of 1979. They are the C-130WBS(wide-bodied STOL aircraft) and the C-130VLS with increased transport capacity and speed. Both of them will be equipped with two new Allison turboprop engines, the M70 and M71, now under development.

CSO: 4120

ECONOMIC

COUNTRY TO SELECT YXX MARKET SURVEY PARTNER BY AUGUST

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 2, 3

[Text]

The Policy Subcommittee of MITI's Aircraft and Machinery Industry Council met last week, and heard a report of the Society of Japanese Aerospace Companies' (SJAC) mission which was dispatched to Europe for fact-finding tours of aerospace industries in April. The subcommittee agreed to select by August Japan's partner on market surveys on the next-phase passenger aircraft development program coded in Japan as the Y-XX. Based on results of the market surveys, MITI is expected to request funds for the Y-XX development in the FY 1982 national budget.

According to the SJAC report, leaders of European aerospace industries have indicated that there would be a demand for approximately 2,000 100-160 seat class single aisle passenger aircraft in and after the middle of the 1980s. Fokker Aircraft has expressed strong desires to collaborate with Japan on joint development of the F29. Airbus Industrie told the SJAC mission that it would welcome Japan's participation in its SA (single aisle) aircraft development projects, the report said. Both Fok er and Airbus Industrie have asked Japan to conduct joint market surveys and feasibility studies, the report added.

In addition to these two companies, Avions Marcel Dassault-Breguet Aviation (AMD-BA) has reportedly proposed joint development of a new passenger jet incorporating advanced wing, engine and systems technologies, utilizing the Mercure fuselage.

After SJAC publishes its official report of the mission around June 20, the subcommittee will meet again and select by August Japan's partner on joint market surveys from among Fokker, Airbus Industrie and Boeing.

CSO: 4120

BOEING EXECUTIVES REGARD NATION'S INDUSTRY HIGHLY

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 3, 4

[Text]

"We are very satisfied to see smooth progress in the joint Boeing 767 production program with the Japanese," said W. M. Maulden, Senior Vice President, Boeing Company, during his recent talks with Shohei Kurihara, Director-General of MITI's Machinery and Information Industry Bureau. Maulden visited MITI after an inspection tour of Japanese aircraft plants related to the US-Japan program. During May 12 through 14, Maulden and W. W. Buckley, Vice President-Operations, Boeing Commercial Airplane Co., toured FHI's Utsunomiya Plant, MHI's Nagoya Aircraft Works Oye Plant, and KHI's Gifu Plant. On May 15, Boeing executives met KHI Chairman Kiyoshi Yotsumoto and FHI Chairman Eiichi Ohara. After visiting MITI, they held talks with MHI Chairman Gakuji Moriya May 16.

Maulden expressed satisfaction with Japanese efforts in the 767 program and at the same time gave praise to advanced production facilities, during separate meetings with MITI officials and top executives of airframe manufacturers. It is reported that he hinted at furthering current business relations between Boeing and the Japanese through joint efforts for a new aircraft program such as the Y-XX although he made no proposal or commitment to the Japanese.

Maulden and Buckley were sent to Japan by T. A. Wilson, Chairman of Boeing Co., who visited in late March through early April this year. Wilson told Kurihara that Boeing is ready to pursue possibilities for further joint programs such as the Y-XX in the form of a 130-passenger airliner. Wilson during his meetings with top executives of Japanese airframe manufacturers hinted at a joint market survey in this direction.

Mauldén's visit, therefore, can be interpreted as a positive sign of Boeing's interest in the Japanese industry from a long-term business standpoint. It will be interesting to watch how soon Boeing will come up with proposals to keep close business ties, in face of European efforts for a joint airliner program.

CSO: 4120

ECONOMIC

AIRCRAFT EXPORTERS DISCUSS 767 SUPPORT ARRANGEMENT

Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 pp 4, 5

[Text]

The Aircraft Division of the Japan Machinery Exporters' Association meeting May 14 dealt with improvement of the export licensing system and other procedures for smooth supply of Boeing 767 components.

Japanese aircraft manufacturers, participating in the 767 production program, have been required to set up arrangements for supporting the supply of components as 767 production is about to start on a full scale. After delivery of components to Boeing begins, they will have to respond rapidly to Boeing's requests for other components. To that end, export licensing and other procedures must be streamlined. If this is impossible, parts for possible urgent supply will have to be stocked in Boeing's supply depot. Even in this case, an increase or drop in stocks would depend on facilitation of the procedures. Thus, improvement of such procedures is a major problem for aircraft makers.

Other subjects at the May 14 meeting, chaired by Managing Director T. Yamada of Kawasaki Heavy Industries, included a 1981 aircraft guidebook, collecting and analysis of foreign aircraft industry data, and improvement of export statistics.

It decided to issue 400 copies of a 120-page guidebook prepared both in French and English for delivery to foreign clients on the occasion of the 1981 Paris Air Show. Editing will start soon under an ad hoc committee. The association has so far issued such a guidebook every two years.

As for collecting and analysis of overseas data necessary for promotion of exports, participants in the meeting recommended expansion of the association's data collecting network and more detailed analysis.

CSO: 4120

ECONOMIC

BRIEFS

FLOATING CRANE FOR PRC--Tokyo, 14 May--Ishikawajima-Harima Heavy Industries Co announced Wednesday the completion of one of the world's largest floating cranes of the full-revolving type. The crane ship with a slewing capacity of 500 metric tons will be delivered to the orderer, China Salvage Company, Thursday. The ship, named Da-li Hao, is 100 meters in overall length and 38 meters in width. It has a maximum hoisting capacity of 2,500 tons. The floating crane, intended for coastal operation, is priced at approximately yen 4.3 billion (about $20 million). [Text] [Tokyo KYODO in English 0710 GMT 14 May 80 OW]

RECORD CONTRACT MONTH--Tokyo, 28 Apr--Both export and import contracts concluded in March by 13 major Japanese trading firms reached record highs due to firm exports and increase in imports of fuels from Southeast Asia, the Japan Foreign Trade Council announced Monday. The export contracts were up 36.8 percent over the previous year to yen 2.1 trillion and the import contracts up 138.1 percent to yen 2.8 trillion. This resulted in an import excess of yen 7 billion, the largest imbalance since March 1974. It was the first time that both export and import contract figures topped yen 2 trillion. The 13 members of the Japan Foreign Trade Council account for some 60 percent of the country's total trade. Exports gained on all fronts with ships showing the largest increase of 2.5-fold. Due to the rise for ships, machinery increased by 29.8 percent. Metals rose 50.7 percent, foodstuffs 2.2-fold, chemicals 54.3 percent, textiles 36.6 percent and miscellaneous 63.1 percent. In the import sector, fuels registered the largest increase, 5-fold rise, accounting for 60 percent of total imports, followed by chemicals which rose 2.9 times, an all-time high both in value and growth. Lumber increased 90.5 percent, metal 83.6 percent, miscellaneous 41.3 percent and foodstuffs 24.4 percent. [OW281427 Tokyo KYODO in English 0709 GMT 28 Apr 80]

STEEL EXPORTS TO VENEZUELA--Tokyo, 9 May--Nippon Steel Corporation and other major Japanese steelmakers have now an order from Sidor, a Venezuelan state-owned steel enterprise, for export of 118,600 tons of steel during the latter half of 1980, Japan's No 1 steelmaker said Friday. Sidor also accepted a markup in prices for the steel including 10,500 tons of cold coil and 6,000 tons of hot coil. The Japanese steelmakers are exporting 110,000 tons of steel to Sidor during the first half of 1980. [Text] [OW100925 Tokyo KYODO in English 0622 GMT 9 May 80]

INDUSTRIAL MACHINERY ORDERS--Tokyo, 9 May--Industrial machinery orders in the 1979 fiscal year ended March 31 registered an alltime high of 5,108.9 billion yen, up 27.9 percent over the previous year, the Japan Society of Industrial Machinery Manufacturers reports. The association said it was the first time that annual orders exceeded 5,000 billion yen. The previous record was 4,173.1 billion yen in 1977. Domestic demand in fi cal 1979 totaled 2,876.4 billion yen, up 6.2 percent compared with the preceding year, and exports amounted to 2,232.5 billion yen, up 73.8 percent. By item, orders of prime moves totaled 812.9 billion yen, up 6.5 percent over 1978; civil engineering and construction machinery, 995 billion yen, up 18 percent; mining machinery, 76.6 billion yen, up 1.7 percent; chemical machinery, 1,856.4 billion yen, up 60.5 percent sharply; tanks, 113.1 billion yen, down 54.6 percent; plastic machinery, 82 billion yen, up 35.6 percent. Orders of pumps amounted to 205.9 billion yen, up 7.2 percent; compressors, 91.2 billion yen, up 25.2 percent; blowers 52.9 billion yen, up 45.5 percent; material-handling machinery, 208.6 billion yen, up 14.9 percent; change gears, 44.9 billion yen, up 30.7 percent; and metal working machinery, 320.4 billion yen, up 116.9 percent. [Text] [Tokyo KYODO in English 0437 GMT 9 May 80 OW]

PRC ECONOMIC RESEARCH COOPERATION--Tokyo, 3 Jun--The Long Term Credit Bank of Japan announced Tuesday it agreed with the Academy of Social Sciences of China for wide-range cooperation in economic research. The agreement includes exchanges of economic study missions and research data, mutual dispatch of researchers for long term stays and joint sponsoring of international economic symposiums. The Chinese Academy, having more than 20 subordinate research institutes under it, is working out a draft for China's new 10-year development plan. Under the recent agreement, the Japanese bank will send an economists' mission to China 30 June for a 10-day study tour. The mission will be led by Hisaq Kanamori, head of the Japan Ecomomic Research Center. The Japanese bank and the Chinese Academy will start to exchange economists this fall to have them stay for economic study. [Text] [OW040603 Tokyo KYODO in English 1231 GMT 3 Jun 80]

MOUNTAIN ROPEWAY IN SHANDONG--Tokyo, 27 May--Nichimen Co, Tokyo Car Corporation and Tokyo Sakudo Co have jointly received an order from the China travel and tourism administration bureau for construction of a ropeway on Mt Tai Shan, in Shandong Province, it has been revealed. According to Nichimen, it will be the first ropeway to be construction on Mt Tai Shan by the Chinese for the promotion of the sightseeing business in that country. Under the order, Tokyo Car Corporation will manufacture two 31-seat gondolas and Tokyo Sakudo Co will produce wire rope and machinery for the ropeway. Tokyo Sakudo will also supervise the construction work. The ropeway, about 2,100 meters long, will stretch from midway up Mt Tai Shan to its top. Construction of the ropeway will start at the end of this month and will be completed by the 1 October anniversary of the founding of China, next year. The Chinese side will have partial charge of the engineering work, steel tower construction and machinery installation. [Text] [OW281301 Tokyo KYODO in English 0820 GMT 27 May 80]

NISSAN-ALFA ROMEO AGREEMENT--Tokyo, 12 May--Nissan Motor Company (Datsun) has initialed an agreement with Italy's Alfa-Romeo S.P.A. for joint production of small cars in Italy, trade sources said Monday. Nissan, however, declined to comment on the report. The sources said the Italian Government's Economic Policy Committee, CIPI, was not considering whether to approve the projected joint car venture, and would probably reach a conclusion before the Venice summit scheduled for 22 June. The sources said the proposed joint company would build a plant capable of producing 60,000 small cars in southern Italy. Car designs and chassis will be supplied by Nissan, and half of the output will be exported to the rest of Europe through the sales networks of the two companies, according to the sources. [OW141321 Tokyo KYODO in English 0428 GMT 12 May 80]

OIL SURVEY IN PRC--Tokyo, 4 Jun--A survey team will leave for China 20 June for 2 weeks' visit to cooperate in development of Dagang and other onshore oil fields around Bohai Bay, industry sources said Wednesday. China has asked for Japanese help in developing the deeper part of the Dagang field near Tianjin. The mission led by Akira Kujiraoka, director of the Japan National Oil Corp (JNOC), will consist of about a dozen experts of Japan Petroleum Exploration Co, Idemitsu Oil Development Co and JNOC. [Text] [OW040603 Tokyo KYODO in English 0547 GMT 4 Jun 80]

AID FOR THAI RESERVOIR--Tokyo, 27 May--The government decided Tuesday to extend yen 50 million to Thailand for a project to build a reservoir in Klong Khao Larn, water from which will be used by Cambodian refugees staying at camps in the country. A severe water shortage is being suffered at the refugee camps due to the abnormal drought which hit Thailand this year. To ease the situation, the Thai Government is engaged in building small reservoirs in various parts of the country. Of the reservoirs, it is placing priority in the construction of the reservoir at Klong Khao Larn and sought financial assistance of the Japanese Government. It plans to complete the reservoir during the present dry season. [Text] [Tokyo KYODO in English 0342 GMT 27 May 80 OW]

GUANGZHOU FAIR DEALS--Guangzhou, China, 15 May--Japanese traders concluded fewer contracts with China during the month long spring session of the Guangzhou (Canton) trade fair which ended Thursday. The total value of Japan-China trade contracts concluded at the fair was less attractive because China's important export items such as soybeans, fishery products, coal and nonferrous metals were not offered for sale, Japanese trading sources said. Japanese traders have concluded deals on certain commodity items directly with China's state-run trading corporations, the sources said. In addition, similar fairs are held frequently throughout China. These are two major reasons why the fair is failing, they noted. Although the Guangzhou fair is losing its importance as the showcase of Chinese export commodities it is fulfilling a historic role in promoting friendly relations with peoples of the world through trade, some Japanese traders said. [Text] [OW161405 Tokyo KYODO in English 0301 GMT 16 May 80]

JOINT AIRLINER PROGRAM PROPOSED--Etienne Davignon, EC Commissioner in charge of industries, proposed early realization of a joint airliner development program to meet Y-XX requirements during his meeting with Yoshitake Sasaki, Minister for International Trade & Industry, May 16. Davignon proposed the joint airliner program as a measure to strengthen industrial cooperation between Japan and the EC. He did not specify the names of European manufacturers although Japan has proposals from Fokker Aircraft on F29 aircraft and Airbus Industie on SA series projects. Sasaki, however, replied that Japan would try to make a decision soon based on findings of a survey mission sent to Europe in April from the Society of Japanese Aerospace Companies (SJAC). Davignon stressed EC's wishes for positive EC-Japan joint efforts for 1) mutual investments; 2) technical cooperation; and 3) plant exports to third-party nations, and the new airliner program was proposed as feasible step toward these goals. [Text] [Tokyo JPE AVIATION REPORT-WEEKLY in English 28 May 80 p 3]

CSO: 4120

SJAC TO REVIEW COUNTRY'S SPACE INDUSTRY

Tokyo JPE AVIATION REPORT-WEEKLY in English 21 May 80 p 10

[Text]

The Society of Japanese Aerospace Companies (SJAC) has decided to set up a committee to study Japan's space industry in FY 1980. It will cover structural and technical problems involving the industry by comparing it with its foreign counterparts, and consider future prospects.

Japan's space exploration started in 1955 when Tokyo University succeeded in test launching a pencil rocket. In 1959, the Science and Technology Agency established a space exploration preparation committee in its Planning Bureau. In FY 1980, government spending for space exploration amounts to ¥102,000 million, exceeding the ¥100,000 mark for the first time.

During the past, the space exploration industry has grown enough to begin exporting space exploration equipment and annual growth rate has averaged 6.5 percent.

An industrial outlook for the 1980s of the Ministry of International Trade and Industry stipulates Japan's space industry will continue to develop in both sales and technical fields with space exploration technology being promoted.

CSO: 4120

ELECTRIC AUTOMOBILE SAID TO HAVE GREAT PROMISE AS CAR OF FUTURE

Rapid Development Expected

Tokyo DENRYOKU SHIMPO in Japanese Nov 79 pp 107-109

[Text] "The rapid development of 'motorization' has been accompanied by the problem of exhaust gas pollution. In addition, the oil shock of 1973 brought on the need to look for diversification in energy for automobiles as well, and this has directed attention to the electric automobile." This was the statement from managing director Hajime Inoue of the Japan Electric Vehicle Association, Inc.

Since the electric automobile is powered by electricity, it does not discharge exhaust gas, and its fuel does not have to be gasoline but energy from nuclear energy, coal, or some other primary energy sources. Japan's economic society has been branded "oil emaciated," and there is need from here on to effect rapid disengagement from dependence on oil. The same thought also applies to vehicles.

The world's largest oil consumer, the United States, experienced a second oil crisis as an aftermath of the Iranian revolution, and the oil pinch was first felt in the form of a gasoline shortage. The gas stations along the eastern coasts were scenes of winding "gas lines" which continued for days and which eventually resulted in arguments over gas and even bloodshed.

Even assuming that no such incidents as experienced in the United States will happen in Japan, the closing of gas stations on Sundays has been attempted, and the price of gasoline is rising. Now, despite the further lack of oil, there is projected increased demand for automobiles in this country. There are some estimates that place Japan's automobile ownership in 1990 to be of the order of 42-46 million. Any such increase naturally will sharply increase demand for gasoline. Now the fraction of gasoline recovered from crude oil is small in Japan. At the same time, there has been a trend for increased demand for the three intermediate products from crude oil, and it will be difficult to increase just the gasoline fraction. In other words, Japan's gasoline shortage is in a structurally deficient trend.

"A reevaluation of the electric automobile is under way from the standpoint of oil conservation, but this is not all. There are less operational features to consider compared to the ordinary internal combustion engine which enable easy driving and greater safety." This is a point which is emphasized.

In other words, there are a number of merits associated with electric automobiles such as release from use of oil, no pollution by exhaust gas, anti-noise pollution, and safe operation.

Performance Is Best in the World

Such being the case, what is the technological level of Japan's electric automobile? There is confidence presently that its performance is "best in the world."

"In the development of the electric automobile in Japan, its use in mixed traffic with other automobiles was assumed as a result of which greater emphasis was placed on acceleration and hill climbing capability. The electric automobile developed by the large national project has performance standards no different from those of internal combustion engine automobiles." The performance of electric automobiles produced by Japanese makers such as Daihatsu and Mitsubishi Automobile is listed in the accompanying table, and excepting the distance traveled per charge, there seems to be little in the way of performance that does not measure up to the performance of gasoline automobiles. In this sense, it may be considered that the electric automobile has already made the transition from the research and development stage to the popular use stage.

The Japan Electric Vehicle Association is presently promoting greater use of electric automobiles as general use vehicles following the "Basic plan for popular use of electric automobiles" which was drawn up in April 1977. The contents of this plan include the following.

"The JFY 1979 plan of the Electric Vehicle Association provides for the 'formation of round tables in areas of possible expansion,' and the first area to be tackled was the various governmental organizations. For example, the postal services delivery vehicles are prime examples. There actually have been considerable sales, and we are hoping that at least 10 percent of the total number of automobiles will be electric."

Other areas expected to be developed include newspaper and milk deliveries and electric and gas service vehicles. Working under the premise that electricity is instant energy and that a means of using electricity late at night for hot water heaters and electric automobile charging to balance the load would be practical. Chubu Electric once conducted research and development along these lines. At the present time, the results of the large project conducted under the sponsorship of the Agency of Industrial Science and Technology of the Ministry of International Trade and Industry are expected to be highly exploited by the power companies. The most active

members of the nine Power Companies group along this line are Kwansai Electric and Tokyo Electric, and these two companies are directing all out effort in developing this new technology.

Be that as it may, no matter how much the performance of the electric automobile has been improved, it has not yet come up to the level of the general class of gasoline automobiles. This is why director Inoue stresses that this is the stage at which the features of the electric automobile be fully recognized before embarking on development of demand. A start in this direction is the "Electric Automobile Test Use System."

"An electric automobile should suffice as long as the party in question does not make long trips. On the other hand, Japan is not at the stage when a second car is a common practice while the cost factors also tend to place these cars beyond reach. This is why their primary application is targeted for the commercial use area. This is the test use system that is involved, and this is where we expect major results. This is expected to be the springboard through which bakeries and other businesses are expected to widen the scope of applications." The cost is high because demand has not been sufficient. The demand is not there because the cost is high. These are the sore points of the negative environment that have to be turned around.

This is not something limited to Japan alone. Even the United States which has been most heavily engaged in electric car development is butting its head against a similar stonewall. The United States has plans for the production of 10,000 demonstration vehicles, but the problem is, what next? The United States has already enacted the "Electric Automobile Research and Development Promotion Law" in 1976, and a 5-year plan budgeted for 160 million dollars is moving to the executional stage, and the production of 10 million cars by 1990 is targeted. As a sidelight, it is said that once this is accomplished, a daily saving of 500,000 barrels of oil daily will be realized. Just how to implement this large and long term plan is again the major problem.

Leaving performance aside, the country with the greatest number in use is Great Britain. It is said that there are presently 40,000-50,000 electric automobiles in use on the streets of this country today. Practically all milk delivery in London is through electric delivery vehicles. It is said that this practice has resulted because the electric automobile is the only means for effective delivery. The truth is that the British Highway Traffic Law prohibits an operator from leaving a vehicle whose motor is running, and this is why an electric vehicle with no need for idling provisions is preferred.

"In addition, the depreciation period for a diesel automobile is 6 years while that for an electric automobile is 12 years. The electric automobile also has the special feature of suitability for door to door deliveries, no demand for high performance, and battery life is more than 5 years as

a result of which its operating costs are half those of diesel motors. Another appealing feature is the lower cost of electric power compared to gasoline. The reason the electric automobile has found so much acceptance in Great Britain is mainly the Highway Traffic Law, but the economic merits completely control their use at the present time."

Now, how should we go about to bring economic merits to the users in Japan? Certainly, the emphasis on pollution prevention countermeasure or energy conservation is not going to whet the user's desire to purchase electric automobiles when it comes to the buying stage. The most important thing is the realization of the advantages that accrue through the use of an electric automobile.

"While a test system was being urged for Japan, there were incidents such as the one described below which resulted in petitions for a test system. The newspaper delivery trucks come early in the morning to drop off their bundles at designated spots within a residential park, and the noise created by these vehicles was very annoying to the residents. They wondered what might be done, and the net result was the petition."

It is through events such as this that attention is being directed to electric automobiles, but it now becomes necessary to set up a policy to hold this system in place. The most important factor here is reduction in cost, however, Japan's glamor industry, the auto industry, which even technologically is at the top level in the world should not find this cost reduction to be too insurmountable a problem.

"Excepting a few makers, it has been established that most of the makers were directing their technology to the resolution of a series of restrictions on exhaust gas such that they did not have much left to assign to the development of electric automobiles. It is planned to form a "Standard Practical Electrical Automobile Technology Research Group" between 10 automobile makers to take off from the results derived by the large project, and this group intends to produce the national electric automobile model. Plans are being pushed with the expectation that should it be possible to achieve production of one thousand units per month by 1982 the cost can be cut down to a half of what it was before."

It may be said that the maker's side has finally come to the stage that it intends to engage actively in the mass production of electric automobiles, and the makers are making real effort to step up production.

Ideal for New Transportation Systems

On the other hand, just what is the future picture for electric automobiles?

"The electric automobile is powered by electricity and as a result it is very easy to control, and this is what will make these automobiles the base of new transportation systems. This can be illustrated by the dual mode

bus being used at the Tsukuba Research and Academic City which when operated along a guideway can run unmanned and computer controlled. As a result, fixed point stopping is possible, and accelerations and decelerations can be performed smoothly as long as they are programmed. At the same time, collisions can be prevented. Since computer control is exercised, distance between vehicles can be greatly minimized enabling running busses very close to each other during rush hours. In this manner, busses each with capacity of 40 passengers can handle between 7,000 and 10,000 people per hour, thereby greatly expanding the transport potential."

In this sense it may be said that the electric automobile is the future riding vehicle which so quickly has come this far. The new traffic systems using electric automobiles which are being considered include the dual mode system and the palette ferry and city car systems.

The palette ferry system refers to a system in which special guideways are constructed within cities and between cities and automobiles are loaded on palettes (trucks) which are operated automatically by computer control. The electric automobile loaded on the palette is charged during this transport enabling the cruising range of this vehicle to be greatly increased.

The city car system involves special parking lots placed in wide distribution throughout a city in which super small electric automobiles are placed, and these automobiles can be used and left at the closest parking lot in what amounts to one type of rental car system.

The miniaturization of vehicles, their joint use, and the use of electrified automobiles raise the utilization rates of vehicles, roadways, and parking lots. At the same time, automobile caused pollution is resolved making this system one with high utilization value. This system already is being tested in Amsterdam, Holland.

In Japan, plants with very broad factory area such as steel making plants and chemical plants are directing their attention to new traffic systems using electric automobiles.

In this sense, it may be said that the electric automobile is a vehicle with abundant future potential.

When the advantageous features such as nonpolluting, low noise, no need for oil, and optimum adaptability to new traffic systems are considered, the electric automobile is indeed the vehicle of the future, and much can be expected of the Japanese automobile industry because of its technological strength and future-looking property.

Situation of Private Electric Automobile Development Efforts

1	2		3		4		5	6		7	
8	9	10	11	12	13	14	15	EV30	EV[illegible]	16	17
18	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
19	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	—	[illegible]	—	[illegible]	[illegible]	—
24	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
25	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
26	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Key:

1. name of maker
2. Daihatsu Kogyo
3. Toyo Kogyo
4. Mitsubishi Jidosha Kogyo
5. Suzuki Jidosha Kogyo
6. Toyota Jidosha Kogyo
7. Nissan Jidosha
8. model
9. Hizet van
10. Hizet pickup
11. Bongo van
12. Bongo truck
13. minicab truck 30
14. minicar van E 12
15. carry truck
16. cherry truck
17. modified Rollei
18. overall length (mm)
19. overall width (mm)
20. overall height (mm)
21. total vehicle weight (kg)
22. passengers (people)
23. pay load (kg)
24. maximum speed (km/h)
25. acceleration (S) (0-40 km/h)
26. hill climbing capability (6° slope)
27. distance covered per charge (km) (running at 40 km/h)

Improving Reliability

Tokyo MOTOR MATERIAL in Japanese Sep, Oct, Nov, Dec 79

[Article: "Survey on Conditions for Improving Reliability of Electric Automobile"]

[Sep 79 pp 25-32; Part 2]

[Text] 3.3 Runaway Operation

3.3.1 Expository Comment

The phenomenon of no control capability of an electric motor has the potential of resulting in runaway operation in an automobile in which the engine is not stopped unless some suitable operation is introduced.

That is to say, should an electric motor equivalent to an engine not stop but is provided with a clutch, proper operation of the clutch will prevent further supply of power to the vehicle. In addition, the braking power is usually greater than the driving power of the motor, and the vehicle can be stopped with the brakes. Where an engine once stopped will not naturally restart operation, but a motor can restart as long as a circuit passing current remains.

Automobiles are operated by highly trained operators and ordinary drivers driving at the same time, and they, at first glance, seem to be exploiting the same road performance. In another direction, differences in degree of training bring about large difference in the manner troubles are handled.

Based on the line of thought presented above, it is possible to define runaway behavior as a problem on the automobile side in which the vehicle continues to operate by a response contrary to the desires of the driver.

Assuming further that pranks played by children can also come under the category of runaway behavior, a possibility which can be generated is that resulting from the error in not removing the key when leaving an automobile which is a readily plausible occurrence because of the lack of an idling sound.

Some runaway behavior intrinsic to the electric automobile is presented below, and a study of the possibility of its generation will be discussed.

3.3.2 Distribution Lines

1) Abnormal motor operation due to damages in distribution lines of the motor control circuit

Causes: i) Should the power supply switch control circuit be broken, and the main circuit be operated by remote control, there are occasions when the main circuit cannot be cut off depending on the circuit mode. In such a situation pressing the accelerator pedal may cause the motor to turn even though the key is switched off. The actual situation, however, is that vibration resistant design for automobiles with engines have demonstrated very good effect, and the possibility of such events is small.

ii) Should the power supply switch control circuit be shorted and the main circuit power supply be operated by remote control, there are occasions in which the main power supply cannot be cut off depending on the type of circuit. The possibility and the situations are the same as in i).

iii) Should the power supply switch control circuit be grounded, the same situation of i) or ii) will result depending on the type of circuit.

Countermeasures: The troubles mentioned above are generated as the result of deterioration with time or physical stress caused by collisions. Troubles

caused by deterioration can be handled calling in on the experience gained from internal combustion engines, and their prevention is considered to be fairly simple.

Based on the same type experience mentioned before, the countermeasure against trouble is to select a section of the distribution line of relatively small deformation and enclose it. When circuits of the same type are employed, combinations in which the power supply cannot be cut off for the same reasons given before should be removed or some protective measure should be taken.

2) Abnormal motor operation due to trouble in the speed control circuit distribution lines

Causes: Breaks, groundings, and shorts in the current detection circuit can supply erroneous information to the motor control circuit depending on the type of circuit as a result of which a slight depression of the accelerator pedal can cause large current to flow and result in abnormal forward burst.

It is also possible for release of the accelerator pedal for stopping or decelerating resulting in no decrease in revolutions.

Countermeasures: These troubles resulting from the distribution lines can be prevented with the same kind of measures described before. Increasing the wire gage for important sites and sites close to the major trouble spots and providing double insulation can also be effective. On the other hand, the speed and cruising range are small compared to the internal combustion engine and the effects of vibration also are small, and these factors need to be considered when devising countermeasures.

3) Abnormal motor rotation due to shorts in the main circuit distribution lines

Causes: i) Mutual contact between main circuit distribution lines and terminal. This is a malfunction resulting from accidents. For example, the terminal of the brake system may become bent to make contact with other lines making up the bypass circuit or the terminal as a result of which power supply voltage is impressed directly on the motor.

ii) Vibrations cause chafing of the distribution lines resulting in sheath damage and forming a bypass circuit, and the same type malfunction described in i) may also occur.

Countermeasures: This problem can be resolved by precautionary measures so that the terminal distribution lines cannot form bypass circuits in the event of damage or installing these lines where they are less liable to be subjected to mechanical stress. It is also possible to provide suitable support so friction between wires will not occur, and use highly wear resistant material.

In addition, terminals and the like can be provided with rubber caps or covers with high friction resistance property and with structure such that shorts are not formed despite deformations caused by collisions.

3.3.3 Motor, Control Device

1) Abnormal rotation of motor due to shorts at several places

Causes: Depending on the type of circuit used, corrosion tracking [phonetic] following immersion in water of one of the wires within the control device or grounding caused by powder generated by the brushes can be the trigger to the formation of circuits which bypass the control device, and troubles such as the motor beginning to turn as soon as the power supply is turned on can occur. If, in such cases, the case, installation section, or chassis do not have adequate cross sectional area, currents large enough to turn the motor and cause vehicle runaway cannot pass through, those sections which carry the current become red hot, and the possibility of fire is a greater menace.

Countermeasures: When the motor and control device are loaded on the chassis and conditions are right for current passage through the chassis and case are present, the study of the circuit mode and protective measures such as the installation of rubber at the mounting sites for insulation are effective protective measures.

2) Insufficient control due to commutative failure

In the particular case of a control device using a semiconductor chopper for vehicle use in which emphasis is on lightness, commutative failure is a likely occurrence. When the device has amassed considerable record of effective operation or when effective countermeasures have been made against internal and external noise, the value at which this type incident appears is so small as to be imperceptible. On the other hand, as the number of electric automobiles grows, the probability of its occurrence is inevitable despite the low rate of incidence because of the large number of vehicles involved.

The practice at the present time when commutative loss is detected is to remove the power supply relay through remote control. Here we will examine the various parts of the chopper.

1) Reduced commutative capability due to lowered commutative condenser capacity

Causes: Switching is performed with the charge stored in the commutative condenser where a chopper device is involved, and condenser loss increases the larger the number of repeats per unit time with accompanying evolution of heat. This is why the usual practice is to use a material with small loss in the construction of the condenser, but the deterioration associated

with the temperature rise history varies with the manner in which the vehicle is operated. That is to say, deterioration takes place faster the higher the fraction of switching at high frequency such as at limited current.

This is why differences in road surface, load, and distance traveled naturally varies this thermal history, and the possibility of deterioration increases the more the use conditions exceed the set conditions or when there is long duration of use. Deterioration most commonly appears as punk [phonetic] or decreased capacity. A decrease in capacity is accompanied by reduced charge, and the reverse bias time of the element is reduced should capacity be lowered, and troubles such as commutative loss are experienced when the current is large.

Countermeasures: Since deterioration is represented by extended time of the current and frequency, tests are conducted at the design stage from which the safety ratio can be determined for inclusion in the specifications in one way of preventing this type of trouble. There is a proposal to specify effective life including battery life for power use and vehicle life.

ii) Erratic operation of gate circuit

Causes: Vibrations and moisture cause resistances to increase at weak current circuit connectors as a result of which partial voltages in the signals of the digital circuits are created so that the threshold value is not attained. Other troubles such as changes in current detection values are created as a result of changes in analog levels. When that happens, it may be judged that current is not flowing and an attempt may be made to turn the full current on by pressing all the way down on the accelerator pedal whereupon the voltage of the power supply is added on to the motor.

Countermeasures: The circuits for current detection and where these types of troubles most likely occur should be deployed as close together as possible, the number of connectors should be reduced, and considerations be directed at keeping moisture out. This has actually been done including countermeasures against vibrations.

iii) Erratic operation due to damage to commutating element

Causes: The triggering order of the circuits may go haywire or high voltage is imposed to cause damage to the element. A design that does not take into account and allow sufficient margin in operation for operation during charging or regeneration during steep climbs, increase in internal battery resistance, and regeneration with faulty circuit connectors which can cause high voltage to be generated is inviting trouble in the form of damaged element.

This result in commutation failure, and releasing the accelerator pedal may not stop the motor when a detection circuit is not installed.

Countermeasure: Installation of a commutation failure detection shielding device as well as a protection feature with fuse connection which also includes braking power.

iv) Loss of control due to erratic operation of commutation failure detection circuit

Causes: Commutation failure detection arouses the trigger pulse (for turning off) and compares the voltage or current with the set value after a given time. Judgement is made with a Schmidt circuit, and the power supply switch is tripped should there be abnormality in the routine that is followed normally. Consequently, should there be some error in either the power supply switch trip coil, Schmidt circuit, or the logic, the system no longer operates.

When commutative failure occurs and this type of troubles sets in, stepping on the accelerator pedal applies full voltage on the motor, and the vehicle will leap forward under full acceleration.

Countermeasures: It is thought that a commutative failure detection circuit usually can be rigged up with fairly small number of parts, and increasing the design strength of these parts should increase reliability and also prevent these troubles. There is also need to make some provision for using braking power to help control the situation.

v) Troubles due to faulty return of the accelerator pedal

Causes: During the period when the accelerator pedal was not coated, the cable outer layer and the core wire became split finely to increase in resistance and the pedal did not return in a behavior very rarely experienced with engine run cars.

Furthermore, a similar type of trouble occurs should the return spring be damaged. In such a situation, the other hardware judges that the accelerator pedal is depressed and the vehicle is running so that releasing the foot from the accelerator pedal will not cause any decrease in vehicle speed in the situation that is created.

Countermeasures: Introduce return springs to both the pedal side and the unit side, use coated cables, rust proof metal parts such as springs, and introduce corrosion prevention measures. This program has for the most part been introduced at the present time.

vi) Main circuit relay sticking

Causes: Where a relay control mode is concerned, complete elimination of arc sputtering during relay operation which cuts down on contact point life cannot be achieved. This is why as the period of use lengthens, relay operations occur with very little interval in between such that reverse

electromotive force is small, and large current operations occur frequently and the possibility of contact point sticking becomes greater.

This is manifested in vehicle operation as lack of slowing down response when the foot is taken off the accelerator pedal or as full acceleration just as the accelerator is touched.

Countermeasures: Involve both fuse and braking force into a protective system. A manual cutoff switch may also be provided.

vii) Transistor continuity breakdown

Causes: When there is breakdown in the continuity stage, the same state as commutation failure results.

Countermeasures: The relationship with brake force is the same as described before, and it is not possible to prevent breakdowns due solely to loss in continuity, but introduction of a fuse arrangement as protective measure to cut off the energy supply can be made.

When the overall performance is compared to an engine powered vehicle, mechanical troubles such as of the gears mostly tend to slow the engine vehicle down while the net effect in the case of electric automobiles is that often the vehicle speeds up. On the other hand, an electric automobile equipped with a transmission clutch shows little difference in behavior from an engine type automobile. Even when there is no clutch, increasing braking power and introducing a fuse system should greatly delineate any differences.

3.4 Fire

3.4.1 General Description

Here we look at the automobile with internal combustion engine which has been the mainstay in the past and present and the electric automobile with respect to fires taking place in these vehicles and compare their similarities and dissimilarities. There is, first of all, the difference between the fuel tank and the storage battery which are the energy sources and the differences between the internal combustion engine and the electric motor which are the energy conversion devices which are major differentiating features. As a result, there is naturally major differences between the devices which transmit energy from the energy source to the energy conversion device.

That is to say, the differences between the fuel pipe which transports gasoline and the power cable which conducts the electric power and between the energy flow control unit in the form of the fuel pump (carburetor) and the electrical controls are very obvious. There is, in addition, the major difference between the gasoline stand where energy is replenished and the

charger. In the case of the electric automobile this charger may be placed on the automobile itself or owned individually.

The fuel tank is a source of very great hazard as far as fires are concerned in the case of the internal combustion engine automobile, and this is a major source of direct or indirect fires when accidents occur. The same things may be said with regard to the fuel pipe and the fuel pump. These hazards have been decreased by proper mounting of the fuel tank and fuel line installation.

In the case of a gasoline engine the energy conversion system involves explosive combustions within the engine, and this combustion exhausts high temperature gas which is discharged to the atmosphere by way of the exhaust pipe, and this is very perilous situation as far as fire caused troubles are concerned. On the other hand, long years of experience with the internal combustion engine automobile have evolved countermeasures which afford a reasonable degree of safety under the usually expected conditions and environments.

In another direction, in the case of the electric automobile, as long as the battery is limited to the storage battery, the power source can be considered in the same light as the accessory battery on an automobile, however, the energy stored is considerably larger. This introduces a new hazard factor. In addition, the use of new batteries introduces new problems.

Looking now at the motor and control equipment of an electric automobile, these are safe under normal conditions of use, and any danger from fire involved accidents is far smaller compared to the internal combustion engine. On the other hand, the overall handling including maintenance and handling may need some more study.

There is need to classify the potential sources of trouble when the process which lead to fires in electric automobiles are being considered. First of all, a major classification can be made in the form of externally caused and internally caused fires. Externally caused fires include fires as the aftermath of natural disasters or manmade fires, fires of accumulations of hazardous materials, fires caused by lit cigarette butts left in the automobile, and fires that result from automobile accidents.

Among the fire causing factors which can be directly attributable to the automobile itself include those due to imperfect design, those arising from unsatisfactory service and maintenance, those due to the user's inept handling, fires originating from the charger to which connection was made, and induced fires from electrical sparks from some hazardous zones. These factors often are mutually interrelated, and clear demarcation between the different factors often is difficult.

When the process leading to an electric automobile vehicular fire is considered, it is important to place emphasis on generation of abnormal heat

sources, conflagration or sparking of surrounding sections, heat damage from surrounding fires, and the course of the fire until the entire vehicle is in flames. Abnormal heat sources refer to those sites at which temperatures greater than the limiting design temperature arise as the result of factors of the type classified in Fig. 4, and time related conditions can also be added on here. When the heat resistant limit is attained at the peripheral material resulting from the generation of abnormal heat sources, a fire incident results. Such an event is usually accompanied by the generation of smoke and unpleasant odor which often are the first indicators of the fire. If left unattended, the probability is great that an even worse environment will result, and the heat source may enlarge. If now the damaged sections rise to ignition temperature and the proper environment is there, ignitions result inviting conflagration of the peripheral section. This process is complex, and it is very seldom that the process develops to the stage of fire over the entire vehicle. There is not a situation experienced with gasoline automobiles in which ignited gasoline puts the entire vehicle in flames in almost instantaneous manner.

With this in mind, the section below will study the various components of an electric automobile according to their involvement as fire causing sources, and a study on the methods of improving reliability against such factors will be presented.

3.4.2 Chassis

These are the components associated with the chassis, and those chassis components of an electric automobile which can be tied in to fire causing factors include the electric distribution cable. The other sections are almost the same as for an internal combustion engine vehicle and will not be discussed here. The device for storing the battery will be discussed under the subject of batteries in 3.4.4.

Here a classification of factors associated with the distribution cables of an electric automobile will be made, and the major classification is to power distribution to the main motor and distribution lines for use with various controls. The power cables generally pass through large currents of the order of 10-300A, and current is usually supplied from the battery group to the control devices, through the commutating reactor, and then to the motor.

Furthermore, there is very little attempt at cutting back on the number of these lines such as using the chassis as ground for auxiliary equipment lines.

At the same time, control use and auxiliary equipment use cables are usually AV cables of the same type used in automobiles (low voltage vinyl cables for automobile use). A low voltage of 12V is most commonly used with current below 10 A.

```
                   (Power cables (mainly rubber insulated cables)
                   (
Electric cables -- (Control use cables (mainly AV cables)
                   (
                   (Auxiliary equipment cables (mainly AV cables)
```

Figure 3.4.3. Classification of Cables for Electric Automobile Use

A study is presented below on the phenomena which are expected to be associated with fire damage of these distribution lines.

1) Short

An electrical short can be cited as a phenomenon which can be tied in with burn damage off electrical cables. The following shorting situation can be conceived.

```
         (Short within distribution circuit
         (
Short -- (Interbody (ground) short
         (
         (Intercable short
```

A short within the distribution circuit is the situation in which the load is zero within the closed circuit which includes the battery, and the conduction joule heat causes the insulation material of the cable to burn. The motor and control device are likely candidates where such shorts occur. When this type of short in the closed circuit which includes the battery takes place, the method most commonly used to react to the short is a fuse or automatic cutoff breaker to automatically open the circuit. As a result, it is very seldom that the short progresses to the stage that a cable actually burns. On the other hand, the erroneous installation of a larger fuse than specified can result in a serious problem.

A to body short is one in which damage to a cable insulation results in contact to the body and resulting short. Factors responsible for insulation damage include insufficient cable capacity to take care of overload or mechanical wear of the insulation as the result of improper location or installation of the cable. In such cases the joule heat of the conductor and direct damage resulting from arcing can cause insulation damage. Here again protection is offered by fuses or automatic breakers.

An intercable short is when insulation breakdown of cables results from contact between a number of different cables causing a short, and the responsible factors are the same that were described above.

The following methods are commonly employed as engineering countermeasures to prevent shorts in the electrical lines of the types discussed above.

i) The selection of the capacity and insulation of the cable for use will take into consideration the conditions and environment of use.

ii) Always install automatic cutoff devices such as fuse in the closed circuit which includes the battery.

iii) Provide adequate strength to the method of installing cables.

2) Poor contact of terminal sections

A behavior of electrical cable which can be related to burn damage is loosened contact of the cable terminals. The following phenomena related to terminal sections can occur.

i) Poor contact at the pressure contact terminal section of power cables

ii) Poor contacts between various connectors

Since the power cable of an electric automobile conducts large current continuously, poor contact of the pressure fitting terminal section can generate heat and associated problems. The major factor responsible for poor contact is probably the loosening of the clamping bolt as the result of vehicle vibration.

A wide array of connectors made of resin is used extensively on control line cables, and these are sometimes rendered to poor contact condition due to vibrational strains and erosion by water. Because of the small currents involved, these situations seldom lead to fires.

3) Overload use

When an overload current flows through the circuit and exceeds the permissible current of the cables, and cables heat up through joule heat and can even burn.

Factors responsible for the flow of overload current include hill climbing at above the design value and damage to the motor or control equipment. On the other hand, it is the general case that warning devices are installed along with protective devices such as fuses, and it is very seldom that a fire stage is attained.

The following engineering approaches have generally been adopted as countermeasures to prevent overload use.

i) Control the current to the main motor through a maximum current control device.

ii) Install a warning light which goes on whenever the permissible current is exceeded.

iii) Install devices such as fuse to shut off current whenever the permissible current is exceeded.

iv) Provide suitable overload resistant margin.

3.4.3 Motor

The motors used on an electric automobile can be grossly classified into the main motor for power use and accessory motors such as the motor used to power the cooling blower. Here we will discuss items which relate to both types of motor with regard to automobile fires. As may be deduced from the fact that electric automobiles are being produced which comply with the standards for explosion proof construction of equipment as stipulated by the Ministry of Labor, the basic safety of the electric automobile including the motor is very high.

1) Insulation failure

Insulation failure can be cited as one behavior of a motor which can lead to internal fire damage. Insulation failure is directly related to insulation deterioration, and the following factors can be responsible for this deterioration.

- Deterioration caused by powder generated by brush friction
- Deterioration caused by entry of dust and other extraneous material
- Deterioration caused by heat generation during overload operation
- Deterioration through degrading commutation

Insulating materials for motors generally are classified according to the nature of the material from type H (180°C) to type A (105°C), and it can be expected that prolonged durations at temperatures exceeding the respective maxima can lead to fires. When an electric autombile is considered from the practical viewpoint, small size and light weight are required. Leaving out off road automobiles, it is generally the case that forced cooling blowers are installed, the provisions are made to discharge brush powder and dust to the outside. It is conceivable that degrading commutation during overload use can be due to malfunctions in the control devices, and it is the common practice to provide these devices with some kind of protective devices.

2) Shorts

Shorts in motors can be classified into those which are created between turns of the coils and those created between the coils and chassis. The cause of these shorts can be usually traced to insulation breakdown due to deterioration or manufacturing flaw. Fuses or automatic cutoff breakers are generally installed in the power circuit for protection as a result of which the incidence of fires from shorts is very small.

3) Loosened terminals

The following factors are thought responsible for loosened terminal sections of a motor.

- Construction of the connection section
- Temperature cycle
- Vibrations
- Cable imperfections
- Environmental conditions

On the other hand, automobile fires arising from heat generated by poor contact at the terminal sections are very scarce.

4) Overload

The following situations come to mind which can be responsible for motor fire damage during overload operation.

a) Increased friction in bearing, etc.--burnt bearings

b) Increased resistance to vehicle travel--oil leakage, oil insufficiency, improper operation of reduction gear drive, lack of air, improper vehicle alignment

c) Improper driving--prolonged hill climbing, missed shifting of reduction gears, forgetting to release emergency brake

Overload currents flow in such cases with possible heat generation, but the installation of protective equipment essentially eliminates the possibility of fires.

5) Malfunction of cooling equipment

Air cooling is usually the main stream of cooling modes adopted for electric automobiles and these can include external enforced mode, internal enforced mode, or natural cooling mode. A more common mode of cooling adopted in electric automobiles is enforced external cooling through a blower installed outside the automobile. This mode is adopted in the interest of weight conservation and load considerations as well as the realizable cooling effect during hill climbing. Any malfunction of the cooling system causes motor overheating.

Cooling [illegible] malfunctions can arise from the following sources

- Unfastene[illegible] [illegible]ble
- Worn brushes in blower motor
- Damage to fan
- Damage to air pathway, unfastened duct
- Clogging of air inlet, outlet

Some kind of protective device is installed to guard against cooling system malfunctions in addition to which are the overheating protection devices for the motor which were mentioned before, and these malfunctions are very seldom tied in to motor fires.

6) Other troubles

Other troubles connected with the motor include malfunctions of parts such as the commutative reactor in the circuit which increases current ripple and generates heat or excessively high rotation followed by flash over which can instantaneously cause fires. Although these incidents are theoretically possible, should a fire in a motor occur, it takes place within a steel casing, and its spread to the entire vehicle is rather improbable.

3.4.4 Battery

The batteries used on an electric automobile can be grossly classified into the main battery which is used for power and the auxiliary battery for accessory equipment use. Here we will discuss the items which can possibly be tied in with vehicles fires involving both types of batteries.

1) Short

A battery short can be classified into one taking place outside of the battery and one generated within the battery itself. Shorts outside the battery are caused as an aftermatch of accident or mounting failure which are physically caused factors along with liquid leakage which may accompany the short.

Internally generated shorts include excessive bending or falling off of active material as the result of production oversight or rough handling. The following measures have been directed at trying to rectify this type of trouble in electric automobiles.

° Install automatic cutoff devices such as fuses within the battery connection line
° Pay close attention to the battery mounting
° Protect battery terminals
° Perform spot inspections and maintenance carefully

2) Current leakage

Leakage of current from a battery can be divided into those between the battery and terminals, battery terminal and liquid plug, battery terminal and body (ground), and battery case and body (ground). This current leakage often is caused by electrolyte solution leakage, and the following causative factors come to mind.

From the handling standpoint overcharging, low liquid level, and excessive deterioration of the battery can result in thermal deformation which cracks the battery case thereby allowing electrolyte to escape and current to leak. There also can be liquid leakage resulting from excessive filling.

From the structural standpoint malfunctioning liquid plug, malfunctioning connection section of the battery case, poor contact at the terminal section, improper mounting on the automobile, and bombardment with extraneous materials from the wheels can damage the battery case and cause leaks. When an accessory one piece water filling attachment is installed, lack of air tightness of the liquid filling line can cause liquid leaks. The following considerations usually are directed at electric automobiles.

* Pay particular attention to the installation of the battery on the automobile
* Protect the terminal section of the battery
* Set a low terminal charging current value of the charger in order to avoid overcharging
* Keep close watch over the liquid plug and liquid filling line
* Exercise care during spot inspections and maintenance as well as during handling
* Install current leak alarm device on high voltage automobiles

3) Loosened terminals

The terminal section of a battery can become loosened by the following factors.

* Vibration of the battery
* Improper battery installation
* Faulty cable used for the connecting lines
* Heat generation arising from terminal corrosion

Heat generation resulting from loosened terminals on a battery can become a minor factor in inciting the generation of fire from other sources and, therefore, should be carefully checked.

4) Other causes

Sparks from external fires can be considered to be a possible cause. The spark can come from a lit cigarette, electric arc from an electric unit, and sparks from control equipment (such as contactors) and induce battery explosion. The following measures are usually taken where electric automobiles are concerned.

* The battery is provided with enclosed structure
* The control device is enclosed in a case and installed with care particularly with respect to the position

2.4.5 Control device

The control devices most commonly used on electric automobiles include resistance control, thyrister control, and transistor control, and most of these are enclosed in cases. At the same time, there are few flammable items among the components of a control device, and it can be said that the safety of the control device of an electric automobile is basically very good.

1) Insulation failure

Insulation failure can be cited as one behavior which can be tied to the occurrence of fires within the control device. Deterioration of insulation of a control device can be directly tied in to temperature and duration of use just as with the motor and may be considered one of the important factors which determine life. Insulation failure may be caused by the following.

* Deterioration resulting from entry of moisture, dust
* Deterioration by heat resulting from overloading
* Deterioration due to environmental conditions (penetration of fog, gases generated by electric arc, etc.)
* Deterioration due to vibrations

On the other hand, some protection is almost always devised, and the incidence of fire is very small.

2) Short

Shorts in the control device can be divided into shorts created between internal parts and shorts between constitutive parts and chassis (ground). These shorts can be caused by deterioration from long term use or structural imperfection (improper assembly) which create insulation breakdown. When an automobile is being operated, some automatic cutoff device such as a fuse is installed in the power circuit and the possibility of fires caused by shorts is small.

Table 3.4.1. Basic Structural Difference Between Internal Combustion Engine Automobile and Electric Automobile

	(1) 内燃機関自動車	(2) 電気自動車
(3) エネルギー源（貯蔵装置）	(4) ガソリン（軽油）タンク	(5) 電池群
(6) エネルギー伝達装置	(7) フューエルパイプ	(8) 動力配線
(9) エネルギー制御装置	(10) フューエルポンプ キャブレター	(11) 制御装置（コントローラ）
(12) エネルギー変換装置	(13) エンジン	(14) 電動機
(15) エネルギー補給装置	(16) ガソリンスタンド	(17) 充電器 内蔵型 (18) 据置型 (19)

Key:

1. internal combustion engine automobile
2. electric automobile
3. energy source (storage device)
4. gasoline (light oil) tank
5. battery group
6. energy transmitting facility
7. fuel pipe
8. power cable
9. energy control device
10. fuel pump, carburetor
11. control device (controller)
12. energy conversion facility
13. engine
14. electric motor
15. energy supply facility
16. gasoline station
17. charging unit
18. self contained
19. established type

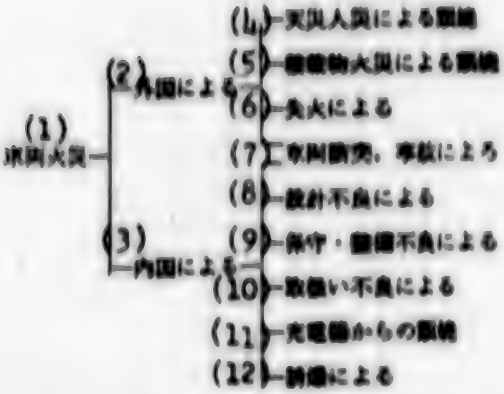

Figure 3.4.1 Classification of Vehicle Fires

Key:

1. vehicle fires
2. due to external factors
3. due to internal factors
4. destruction by natural fires
5. destruction by fire of accumulated materials
6. accidental fires
7. fires due to vehicle collisions, accidents
8. due to design inadequacies
9. due to improper service and maintenance
10. due to improper handling
11. destruction by charging unit
12. due to induced explosion

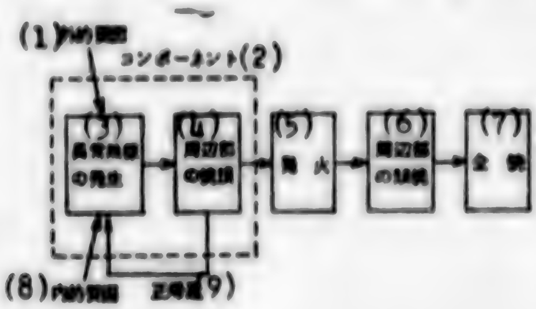

Figure 3.4.2. Process Leading to Vehicle Fires

Key:

1. external factor
2. component
3. generation of abnormal heat
4. damage to peripheral section
5. ignition
6. destruction of surroundings
7. total combustion
8. internal factors
9. positive feedback

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[Text] (3) Loosened terminal sections

The following factors are thought responsible for loosened terminal sections within a control device.

a) Construction of the connection section
b) Vibrations
c) Cable failure
d) Corrosion due to environmental conditions

On the other hand, it is a very rare incident for connection failures to generate heat to the stage of fires.

4) Overloading

The following are cases in which overloading of the motor affects the control device

1) Increased friction of bearings, etc.--frozen bearings

2) Increased resistance to vehicle travel--oil leakage, lack of oil, failure of drive sections such as speed reduction, gears, lack of air pressure, improper vehicle alignment

3) Faulty driving--use of unsuitable gear stage for hill, long distance climbing, missed gears during shifting, forgetting to release emergency brake

An overload current flows in such situations. The electronic element considered to be the most important of the component parts generally is thought to be damaged and burns should the junction temperature exceed the permissible temperature. On the other hand, the thermal energy generated by the breakdown of these parts is small, and some kind of protective device is usually installed thereby greatly reducing any chances of fire and accompanying damage.

5) Other factors

The site of the heat emitting body installation should be carefully considered, and the use of protective covers or similar parts is necessary should resistance control with a heat emitting body be used.

3.4.6 Charger

Chargers used with electric automobiles can be classed under two major divisions. The first is the fixed type of stationary charger and the other type is the vehicle borne type which is carried on the automobile. Vehicle fires caused by these electric automobiel chargers will be discussed here.

1) Insulation failure

The charging consent section and the charger transformer section can be cited as possible sites of insulation failure on a charger. In the case of the consent section adhering water as from rain may cause electrical erosion resulting in heat generation in the consent followed by conflagration. Insulation failure of the transformer section of the charger may be caused by:

a) deterioration by heat generated during overload

b) deterioration due to penetration of moisture or dust

On the other hand, a fixed charger is separated from the vehicle while the vehicle borne unit is enclosed in a steel case as a result of which any possibility of vehicle fire is very small.

2) Shorts

Shorts in a charger can be separated into those created between the coils of the transformer and those created between the transformer and the chassis. Permanent deterioration or manufacturing imperfection can be thought to cause insulation breakdown and cause shorts. It is the usual case that the power circuit of an electric automobile is protected with devices such as fuse or automoatic cutoff breaker as a result of which fire damage by short is thought to be a very remote possibility.

3.5 Running Abnormalities

3.5.1 General discussion

The motor, control device, battery, and other parts which comprise the electric automobile can be designed to incorporate various kinds of parts and structures, and a detailed discussion of all these different items is out of the question. This section will consider DC motors with commutators while the premise will be made that the control device is either of the three most widely used types; thyrister chopper type, transistor chopper type, or the resistance type. A large number of different battery types have been developed, but here we assume the use of the lead-acid battery that has been widely used from the start.

While the above limitations may have been imposed, there are still some individual traits in the method of design or the method of makeup according to the maker, and specific discussion of the causative factors and countermeasures cannot be made. With this in mind, this paper will restrict itself to countermeasures policy for those items which are commonly predicted.

The subjects were classified and are discussed as to body, motor, control device, battery, charger, and accessory equipment. The discussion under

body was limited to only those related to installed parts unique to the electric automobile. While terminals and fuses can be thought to be installed on the body, terminals are discussed under motors. Fuses are discussed under the heading of control devices. When these parts are installed on the body, they need to be installed with the same care and considerations.

Point inspections and repairs are performed when an electric automobile generates trouble during use, but should the handling be hazardous or considerable time and labor be required for point inspection and repair, the inactive time becomes long which will stand in the way of the popular acceptance of the electric automobile. With this in mind, the design should be adopted which allows ready inspections, repair, and replacement. At the same time, the electric motor will most likely be disassembled, assembled, and repaired at a service plant, and here again a design which facilitates this repair operation is necessary.

The points taken up here were adopted by the electric automobile from the outset of its development, and it is hoped that electric automobiles of high reliability will be developed in short time.

There is as yet no systematic handling of factors responsible for malfunctions of electric automobiles that can be found in the literature, but the list given below is though to offer some useful references.

a) Some Aspects of Electric Vehicle Safety, G.G. Harding Lucas Batteries, Ltd., United Kingdom the Fifth International Electric Vehicle Symposium 78306 (E)

b) Protective Measures and Protection Equipment in Drive Systems for Electric Vehicle, H. Kahlen Brown, Boveri and Cie AG, Federal Republic of Germany, the Fifth International Electric Vehicle Symposium 78305 (E)

c) State-of-Art Assessment of Electric and Hybrid Vehicle (Jan 1978) Reliability and Maintainability P 86-90. NASA Lewis Research Center

d) Standard Battery Powered Industrial Trucks, Underwriters Laboratories, Inc., USA

3.5.2 Body

1) Distribution cables

The voltage of the power source in the form of a battery for an electric automobile is much higher than that used on a gasoline automobile, and this current is insulated from the body in the interest of safety as a result of which the distribution lines are more complex. The distribution lines include the main lines which distribute the power necessary to provide the motor and control unit their ability to generate the driving force and the signal lines which pass the current used for control. These distribution

lines all play important roles in the operation, control, and safety of the electric automobile, and problems can be created such as stalled operation, improper control, or safety hazards should these distribution lines be damaged, burnt, or otherwise impaired. In addition, it may be expected that the motor can experience voltage surges several times above the rated voltage depending on the control mode to have some effect on the control. The main types of damages and their countermeasures are discussed below.

i) Damage to distribution lines

Incidents involving the distribution lines include break in the line due to vibrations, damage to the insulation coating, and shorts between cables. These problems can be avoided for the most part by using suitable insulation material and adequate thickness along with anchoring the cable so that damage by vibration does not take place. Care must be exercised to see that a cable does not come in contact with knife edges of the body sections. There may be times when it becomes necessary to enclose the cable in a protective sheath.

When a cable is installed within the cabin, care needs to be taken to install it with possibility of minimum interference to the passengers. When such an installation is unavoidable, it may be necessary to place the cable in a duct to remove any uneasy feeling on the part of the passengers.

Whenever a cable is to be bent, too small a radius of curvature can damage the insulation coating, and any bending should be made within the recommended limits to radius of curvature given by the manufacturer.

ii) Fire damage to distribution lines

Fire damage to distribution lines can result from rise in temperature due to over current flow, loosening of terminals, or poor contact resulting from corrosion. There is need to select a conductor of sufficient cross sectional area which can withstand anticipated overcurrent levels in order to prevent burn damage. There is also need for protective capability in order to reduce the current before the distribution lines become burn damaged into the electric automobile system with regard to abnormal overloads.

There is need for proper design considerations to guard against loosening of terminals or corrosion of terminals. The reader is referred to 3.5.3 (2) terminals for more detailed information.

iii) Faulty connections

When terminals are removed or connectors are separated during inspections or maintenance, the possibility of wrong replacement comes to mind. These incidences can be minimized by numbering the cable terminals and the contact posts or using some differentiating colors. There is need to color code connectors and to vary the number of connector poles so that erroneous junctions are not made.

iv) Preventing electrical surge in signal lines

Lines of signal circuits need to be removed as far as possible from main distribution lines so that surge voltages in the main lines do not induce faulty operation of the signal lines when electronic control is used. When a signal line has to come close to a main line, it should be placed so that it does not run parallel to the main line. Any site where there is particular danger of faulty operation should be safeguarded by the use of shielded cable.

v) Damage to connectors

The connectors which join signal lines can deteriorate with time as the result of oxidation or moisture effects, and connectors of high reliability need to be selected.

When moisture as from rain penetrates a connector, poor connection may result or current leakage between wires may result which may sometimes cause the control device to become inoperative making it necessary to select sites safe from exposure to rain for placing these connectors. The use of protective caps to guard against rain entry is also possible.

2) Reverse connection of battery terminals

When reverse polarity connections are made to the main battery or the auxiliary battery, burn damage or malfunction of distribution lines or control quipment can result, and there is the possibility that control can no longer be exercised. There is need to provide some scheme in the connection gear to the main or auxiliary battery such that reverse polarity connections cannot be made. Should such a construction not be possible, protective devices to guard against damage states being attained or to install diodes or similar devices to guard against erratic operation should the control device be damaged are in order.

3) Improper functioning of the accelerator pedal

A link mechanism is activated by pushing down on the accelerator pedal of an electric automobile which through the accelrating signal generation device (transducer which converts the mechanical displacement of the pedal to electrical signals) causes operation of the control device and exercise speed control.

Should this link mechanism be damaged, running control is no longer possible. As a result, the link mechanism has to be designed to possess high reliability and superior wearability.

It is also desirable that return springs be installed to both the accelerator pedal side and the accelerating signal generation device so that the vehicle can be brought to a stop even when the link mechanism is damaged.

4) Damage, abnormality of switches

It is expected that a number of switches other than the key switch will be used on electric automobiles. These switches should be able to reliably cut off those circuits through which prescribed voltages and currents flow. They should be selected to provide reliable long term service in stable manner.

As far as switches operating on mA and uA circuits are concerned, they cannot be expected to enjoy the cleaning effect that is provided by arcing at the time of switch cutoff, and materials have to be selected in the production of these switches so that oxidation of contact points and changes with time do not cause poor contacts.

There can be some switches which chatter so severely when they are closed that the operation of the control circuit may be affected as a result of which a control circuit which is affected by switch chattering or switches with little chattering need to be selected.

There are situations in which once a user acquires his own automobile, he puts a number of other items such as a back buzzer in with the switch. This may result in the switch capacity being overtaxed, and the life of the switch may suffer so that there is need to set up limitation on what can be installed and define clearly what items can be installed. The switch should be selected with this capacity in mind.

3.5.3 Motor

1) Distribution line

When there are no distribution lines or terminals at the inner section of the motor to connect to the terminals at the outer section, there are distribution lines available which were prepared for connection to other equipment. In such a case, one end of the distribution cable is provided with a terminal connector. The cautions described in 3.5.2 (item 1) need to be heeded here. The motor shielding and the section of the end bracket where lines pass through are particularly prone to be sources of damage, and some sort of protective sheath needs to be used. At the same time, sufficient clearance should be provided at the inner section of the motor so that no damages result from contact with fixed sections, and the cable should be firmly fixed in place.

2) Damage to terminals

Should terminals become loose or corroded, electrical contact becomes poor, and high temperature may be created at the contact section to cause cable to smolder or the supporting insulation of the terminal to smolder. When there is poor contact, the specified current no longer flows in the cable, and speed cannot be increased. Acceleration and hill climbing power are

impaired, and even running itself may be jeopardized. The following considerations need to be made for the terminal section at time of design.

i) The metal used to conduct current at the terminals should not be selected from those contact resistance increases with oxidation, and some appropriate plating may be used in some cases.

ii) The terminal be provided with sufficient contact surface and current passage cross sectional area so that the expected loads or overloads which are experienced do not cause excessive rise in temperature, cause insulation of cables and terminal support to smolder, or cause poor contact as the result of creep of metal sections.

iii) Thought be directed at preventing entry of rain or dust to the terminal sections.

iv) Support insulation should possess adequate heat resistance and should not ignite with rise in temperature.

v) Insulating materials usually have the property of shrinking slightly at high temperature, and a construction must be adopted so that any such shrinkage will not cause loosening of the clamping sections. Assuming a structure of the type illustrated in Fig. 3.5.1 is used, poor contact will result should there be shrinkage in the L direction of the insulating material, and this type of structure should be avoided.

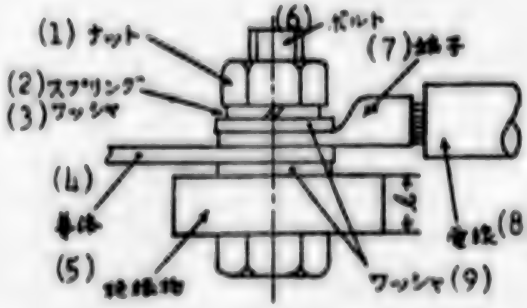

Figure 3.1.5. Unsuitable Terminal Structure

Key:

1.	nut	4.	conductor	7.	terminal
2.	spring	5.	insulating material	8.	cable
3.	washer	6.	bolt	9.	washer

vi) Other items

The studs or bolts of the terminal should be provided with sufficient strength to enable reliable clamping. Sufficient gaps should be provided

between terminals as well as adequate insulated area. Furthermore, the terminals should be signal coded in order to prevent erroneous connection.

3) Incidents involving motor coils

Should open circuit or short circuit of the motor coils or field coils occur, running capability or increase in speed capability may be lost, and hill climbing and accelerating power may decrease. Should the coils short to the yoke, end bracket, or iron core of the rotor, danger from shock results, and this should be avoided in the interest of safety.

In order to prevent such incidents, the field coils are protected by suitable insulating material of adequate thickness and with coats of varnish between layers and on the outside. At the same time, they need to be held in place by suitable clamps which are not damaged by vibration. When excessive clamping force is used, there is danger of the peripheral insulation or interlayer insulation being damaged. When clamping is insufficient and there is some contact with the sides, vibrations cause damage to the insulation. There are times when spacers are used to adjust the clamping, and the spacer must be selected so that it will not change in thickness with the passage of time.

At the same time, suitable insulation and varnish should be used for the rotor coils along with design that will not suffer from centrifugal force and vibrations. When the rotor is being inserted within the slot, suitable space factor or clearance should be assured, and every effort must be made to prevent damage to the insulation.

4) Brush wear, commutator abnormalities, poor commutation

i) Brush wear

The brush is worn through use and should be replaced before its life runs out. There is need to provide the brush with a limiting wire which clearly displays when the brush is worn down to its limit.

In addition to normal wear, there are times when the brushes undergo abnormal wear. These incidents occur as the result of factors listed below and the abnormalities of the commutator described in ii, and measures to guard against these incidents are necessary.

イ) Use of brush made of material and dimensions other than the normal brushes optimum from the commutative and life standpoints are used in the usual type of motors, and the use of brushes of the wrong material or dimensions causes poor commutation. Brushes of the material and dimensions given in the manual must be used in order to avoid such events, and the brushes should be clearly marked with identifiable product number or material.

Z) Brush spring abnormality

Should the brush spring undergo abnormal behavior and brush pressure is reduced, abnormal wear resulting from poor contact or poor commutation may result. There is need to adopt a construction here so that there is no loosened spring resulting from vibration and no loss in spring pressure with water. At the same time, thought needs to be directed at the selection of spring material and provision against rain and dust entry so that rain and dust do not rust the springs and cause abnormal behavior.

∕∖) Brush holder and poor brush slide

This is a behavior observed when the proper brush clearance from the brush holder is not provided or when the brush holder is rusted or clogged with rubbish.

There is need from the design standpoint to assure smooth sliding through the specification of suitable dimensional tolerances and to prevent brush chattering should the clearance be excessive. When plastic is used to make the brush holder, clearance due to contraction is lost, and care is necessary that smooth sliding is not impaired.

To be sure, every effort must be made to prevent the entry of rain and dust into the motor interior, and care is necessary in the site of motor mounting and the cooling air inlet. Material which does not rust easily or is protected against rust should be used for the holder.

ii) Commutator abnormalities

A yellow-brown semilustrous surface of the commutator is desirable during use, but the incidence of the abnormalities listed below degrades commutation and sometimes roughens the surface as a result of which countermeasures are necessary.

a) Formation of streaks on the commutator

Streaks can be formed on the commutator in many ways, and these often are caused by the complex interplay of a number of factors.

i) Extraneous matter

ii) Hairlike streaks are formed on commutator surface by moisture

iii) When harmful chemical gases are present. Hydrogen sulfide can break down the insulating film on the commutator surface. Sulfur dioxide gas, ammonia gas, or sulfuric acid are said to generate streaks through electrolysis.

iv) When oil sticks to the surface

v) When the brush material is unsuitable.

[Nov 79 pp 72-75; Part 4]

[Text] (2) Commutator abnormalities

Countermeasures include prevention of extraneous matter and dust entry, and care must be taken to avoid operation in any atmosphere of chemically harmful gases. Care also is necessary to avoid entry of oil from the outside as well as to prevent bearing grease from being flung on to the commutator surface. Sealed bearings should be used, and a construction that will prevent any such incidents should be adopted. The drive shaft of the motor is usually connected to the speed reduction gears, and some sealing mode or structure needs to be adopted so that oil from the reduction gears does not enter the motor and the commutator surface.

Z) Blackening phenomenon of the commutator surface

i) When a number of plates are eroded in equally spaced manner and the surface is roughened or the poles and slot coils are working in unison

° Melting of the solder on the rotor, equalizing coils, and commutator

Countermeasures include prevention of overload which might cause solder to melt and specification of soldering materials and procedure which will minimize such events.

2) Interlayer shorts of rotor coils and shorts due to extraneous matter between commutator plates come to mind.

The considerations described under 3) are necessary to counter interlayer shorts while a fine screen should be placed at the air inlet to the motor to guard against entry of extraneous matter.

ii) When the commutator surface is irregular and severely roughened

1) Aberrations in the main and auxiliary pole pitch, air gap, and brush pitch often occur after disassembly. Countermeasures include the adoption of a construction which facilitates correct assembly after disassembly or to clear specification of the order and method that have to be followed during disassembly and assembly.

2) Improper brush location, wrong brush material

The same countermeasures described in 1) are necessary here also, and the measures described in 3 a) ﾛ) are necessary.

ハ) Copper dragging

The factors responsible for the copper dragging phenomenon in which commutator pieces extend into the undercut groove are not clearly known, but

leaving it unattended will result in shorts between the commutator pieces and development into brushover.

This type of motors should have the commutator piece surfaces refinished and brush material checked to prevent copper dragging incidence.

ニ) Eccentricity of commutator

When the commutator is too far off center, inadequate commutation comes to mind. The eccentricity of a commutator is compared to the following standard using a dial gage (total vibration) which is a criterion and not an absolute standard.

Circumferential speed of commutator (m/sec)	Eccentricity (mm)
45	1.3/100 or less
24-45	3/100 or less
25	6/100 or less

The eccentricity of a commutator is often corrected at a service plant, and there is need for the maker to specify standards for the degree of eccentricity correction to make and to what extent the diameter of the commutator can be finished.

ホ) Roughened surface of commutator, Highmica [phonetic]

When the surface of a commutator becomes roughed or Highmica sets in, commutation suffers making repairs at a service plant necessary. It is important that the maker establish standards for the degree of surface finish precision and the undercutting method.

5) Abnormal temperature rise

a) Abnormal temperature rise in rotor coils, field coils, and commutator

During prolonged hill climbing or when solder sections or connections become loosened, there can be abnormal rise in temperature in the rotor coils, field coils, and commutator leading to burn damage or running abnormalities. It is desirable that protective devices be installed which operate when there is temperature rise above the specified level together with alarm devices and means to lighten the motor load before trouble sets in.

Abnormal temperature rise also can occur when the coolant air inlet is clogged or when the cooling device is damaged. A construction which minimizes dust pickup and cooling devices or high reliability are necessary.

b) Abnormal temperature rise in bearings

Abnormal temperature rise occurs in the bearings should they incur some damage. Some factors responsible for bearing damage include loss of grease, introduction of extraneous matter and dust, and entry of rain or moisture.

Sealed bearings should be used to avoid the entry of dust, extraneous matter, rain, or moisture and special attention should be directed at the shaft bearing. The loss of bearing grease sometimes is the result of water or oil entry into the bearing, and a structure which guards against water or oil entry should be provided.

6) Damage due to overrotation

When the rotational centrifugal force acts on the commutator or rotor coils of a motor causing the guaranteed maximum rotational speed to be exceeded, there is danger that the commutator and rotor coils may be damaged.

Driving conditions which can lead to such behavior are going down a steep road or operating under low gear condition.

In order to prevent such incidents, braking force is applied to the motor whenever the motor rotation exceeds its rated value to prevent operation above the guaranteed maximum rpm. Another approach is to make provisions that low gear can not be used once the rpm exceeds a certain level.

7) Generation of abnormalities

a) Vibrations arising from abnormal bearing wear

When bearings become worn and vibrations set in, abnormal temperature rise or weird sounds may be emitted as a result of which the bearing needs to be replaced. The countermeasures that were listed in 5 b) should be adopted against abnormal bearing wear.

b) Abnormal sliding sound of the rotor

There are times when abnormal sounds are generated by contact between the rotor and pole core as the result of poor tightening during disassembly-reassembly of the pole core and loosening of the clamping screw as the result of vibrations. This is why disassembly-reassembly operations should be performed according to guidelines clearly established by the maker.

Furthermore, the pole core tightening screw should be one of a construction which will not loosen with ordinary vibrations. At the same time, every effort must be made to provide countermeasures to remove abnormal vibrations whenever they occur.

Other sources of abnormal sounds are loosening of the shaft section of directly connected cooling fans, swelling of the rotor coils, and deformations. The direct coupled fan must be securely fixed on the shaft section while appropriate insulation treatment and mounting method of the rotor need to be provided in order to guard against deformation resulting from centrifugal force or rise in temperature.

8) Insulation deterioration

When there is insulation deterioration, a number of running abnormalities can take place in addition to the unsafe nature of current flowing through the vehicle body.

Some factors leading to insulation deterioration include the entry of rain, moisture, dust, or oil, and the countermeasures against such entry described before apply here also.

Powder produced by brush wear adheres to the surface of the insulating material on the internal section of a motor which can be expected to cause deterioration of the insulation. There is need for design considerations which reduce the incidence of such events through measures such as providing adequate distance between insulation and dust source.

3.5.4 Control devices

1) Fuse melting

When a fuse melts, abnormal behavior such as running incapability can result. The melting of a fuse most often can be attributed to a short somewhere in the circuitry, and it is important that the fuse be replaced only after the proper repair has been made and then only with a fuse of the specified capacity and dimensions.

Should a fuse other than the specified be used, there may be blown fuse despite the lack of any trouble or trouble resulting from the fuse not melting even when there is something wrong. It is desirable that the type and capacity of a fuse be clearly indicated.

It is possible that a fuse can blow without a short in time of overload depending on the selection of the fuse, and this is where a temperature protection device goes into action before any such event occurs. Design which avoids fuse blowing in this manner is desirable. It is also possible to consider the use of a no fuse type circuit breaker.

The selection of the fuse holder is an important adjunct to the selection of a fuse. The fuse should be held securely in the presence of vibrations. At the same time, contact resistance between fuse and holder should be small and stable. When this contact resistance is large, heat generation at the contact section can promote fuse flowing.

2) Terminal malfunctions

As discussed in 3.5.3 item 2, the same considerations that were described for a motor also are necessary here.

3) Distribution lines

The same considerations discussed in 3.5.2 item 1 should also apply to the distribution lines for the control device. In the case of control device, the power use thyrister, diode, or transistor have cooling fins attached, and these power semiconductors and fins are expected to experience considerable rise in temperature at large load.

Methods of installing distribution lines so that the insulation of the tables do not come in direct contact with such hot spots should be considered. If such a situation cannot be avoided, an insulated cable of adequate heat resistance should be used.

4) Malfunctions of contactor, relays

a) Melt sticking of contact points

This is when a contact point melts and sticks and can no longer be released. When such an incident occurs, the vehicle may no longer run or can no longer be controlled. Should the automobile undergo runaway behavior, some dangerous accidents can happen if the safety use contactors and relays stick.

Consequently, there is need to select contactors and relays with attention directed at performance and contact point material so that highly reliable contactors and relays are used which do not melt and stick. Should melt sticking occur during use, the trouble must be quickly repaired or the unit replaced.

Melt sticking of contact points has the possibility of occuring when wipe action no longer can be conducted because of contact point wear or when there is poor contact or dirt and oil accumulate on the contact point. It is also conceivable that damage or wear of the contactor and relay mechanisms can also give rise to melt sticking.

The contact point surface must be protected against adhesion of dirt and oil. At the same time, the mechanism section must have a structure of adequate permanence. A material of little surface roughness should be selected in the design. In addition, when the unit is activated, chattering which is a factor responsible for causing roughness should be minimized as well as measures for reducing arc time during shielding need to be adopted.

Furthermore, the same type countermeasures proposed in a) above are necessary with regard to entry of dirt or oil and permanence of the mechanism section.

c) Other malfunctions

Other possible malfunctions which come to mind are those involving interlayer shorts of the excitation coils, severed cables, burnt cables, and insulation deterioration, and thought must be directed at the design to provide excitation coil insulation specifications, proper construction, and proper countermeasure against rise in temperature.

When excitation current to the contactor and relay is shut off at both ends of the excitation coil, a surge killer should be installed just as with control of surge initiation. When this surge killer malfunctions, surge voltage is generated, and the control device may undergo erratic operation.

Studies are necessary on the voltage, current, or power impressed on the surge killer at time of surge absorption in order to prevent malfunctions of the surge killer, and a surge killer whose values fall into these acceptable limits alone should be used.

There is also need for spot checks on the wear and roughening of the contactors and relays, and repair or replacement should be made whenever applicable. The maker should clearly outline the spot inspection, repair, and exchange aspects.

Photo 1. Light Passenger Use Electric Automobile Model EV1 (Daihatsu)

Photo 2. Small Passenger Use Electric Automobile Model EV2 (Toyota)

Photo 3. Light Electric Truck (Toyo Kogyo)

Photo 4. Light Electric Truck (Nissan)

Photo 5. Electric Route Bus (Mitsubishi)

[Dec 79 pp 41-44; Part 5]

[Text] Abnormalities in the control circuit

a) Malfunctions of control circuit parts

The control circuit employs transistors, IC, diodes, condensers, and resisters, and malfunctions of these parts can lead to vehicle running inability or control incapability.

A part with appropriate derating [phonetic] needs to be used in the control circuit, and it is important not to use such parts when the maximum use temperature is exceeded. Large currents fluctuate sharply within the cables of electric automobile circuits, and the control circuit may operate

erroneously under the effect of surge voltages generated in the above manner or may even deteriorate and suffer damage. There is need to install a filter circuit to absorb surge soltages in the control circuit and thereby prevent happenings of the type just described.

b) Abnormalities resulting from current leakage from control circuit

The control circuit incorporates some parts which operate with micro currents. Should current leakage occur as the result of wetting by rain, adhesion of oil, or dirt, control no longer may be possible. This is why the control circuit should be sealed in, coated with insulating resin, or protected with molding.

c) Abnormalities during high temperature

Since the performance of a part used in the control circuit will vary with the ambient temperature, a study needs to be conducted to prevent abnormalities such as control incapability or erroneous operation taking place under the temperatures of use.

d) Other abnormalities

When indicator lamp loads are controlled by the control circuit, a circuit must be employed which does not suffer parts malfunction or control circuit smoldering as a result of changes in resistance of the lamp filament or shorts at the filament section.

6) Malfunctions of power semiconductors for chopper circuit, condensers, and reactors

Malfunctions of the chopper circuit are manifested as running incapability, control incapability, or commutation failure type running abnormalities. The power thyrister, transistors, and diode semiconductors used in the chopper circuit and the condensers and reactors used in commutation should be selected with appropriate voltage, current, and power capacities to withstand the expected conditions of use. A design must be adopted in which heat generated by commutation loss is not radiated to raise temperatures above the permissible level.

The power semiconductor conceivably can function improperly due to surge voltage or deteriorate, and there is need to transform the impressed surge voltage to a voltage permissible for use with the semiconductor through methods such as installation of a surge killer.

At the same time, a semiconductor may suffer deterioration troubles when sharp increases in current or voltage changes are impressed, and the rate of change in these voltage and current values must fall below the permissible rate for the semiconductor.

7) Abnormal temperature rise

When an electric automobile is subjected to long term overload operations such as hill climbing over a long period, abnormal temperature rise is experienced at the power use semiconductor, and the semiconductor can deteriorate or suffer breakdown.

This is why it is desirable that this temperature rise in the semiconductor be detected and some protective device be installed which sounds an alarm or reduces the load.

It is also conceivable that abnormal temperature rise may result from malfunction of the cooling device or accumulation of trash in the cooling pathway, and measures are necessary to remove factors which give rise to such events.

8) Abnormalities due to surge voltage

As mentioned before, the control circuit must be designed with sufficient capability of withstanding the surge voltages generated by the usual operation of the installations and equipment of an electric automobile. At the same time, suitable means of effecting surge voltage control must be exercised on an installation which generates high surge voltages which can have adverse effects on the operation of the control device.

9) Deterioration of insulation

There is need for considerations directed at preventing entry of rain, dirt, or oil which can cause shorts or deterioration of insulations and render control incapability. At the same time, insulation material must be selected which does not deteriorate at the temperature of the use environment and rise in temperature during operation. A sheet which insulates items such as cooling fins should have adequate heat resistance, thickness, and strength and not be damaged during use. The fin surface has to be finished so that there is no knife edge in contact with the sheet, and care must be directed at preventing damage to the sheet.

Adequate intersurface distances and insulation gaps must be provided between conductors at different potentials.

10) Switch malfunctions, abnormalities

Should poor contact, contact point melt sticking, or malfunction of the mechanism of a switch used in the control device arise, there is control incapability. This is why a switch of sufficient reliability must be selected. At the same time, factors which can shorten life such as overtravel should be avoided.

Care must be exercised on switches which pass micro currents intermitently such that prolonged use does not cause changes which cause poor contact.

There are some switches which undergo severe chattering at time of engagement to adversely affect the operation of the control circuit. This is why a switch with low degree of chattering should be selected or measures be adopted so that the control circuit does not operate in erroneous manner.

11) Abnormalities during low voltage

When the voltage of the main or auxiliary battery is down, the control circuit may become incapable of control or erroneous operation may result. It is necessary for a protective device to operate during such a time to prevent incidents beforehand or to devise control circuits which do not malfunction at low voltage.

12) Malfunction of protective circuit

a) Malfunction of circuit to prevent runaway operation

When the circuit to prevent runaway operation malfunctions and commutative failure sets in, the speed may increase contrary to the operator's wish, and a perilous situation may result. This is why the circuit to prevent runaway operation must be designed with high reliability. Should by some long chance a malfunction occur, it is desirable that a manual cutoff of the power supply can be made to stop the vehicle.

b) Malfunction of low voltage protective circuit

It is conceivable that the control circuit operates erroneously even when the low voltage protective circuit malfunctions, and this protective circuit must also be provided with high reliability. Should by some long chance a malfunction occur, it is desirable that abnormalities which lead to dangerous situations such as commutative failure do not occur.

c) Other malfunctions of protective devices

In addition, the ovverrotation prevention circuit for the motor and the abnormal temperature rise protective circuit should be provided with adequate assurance of reliability. An item of great importance to the protective circuits particularly with regard to safety is that daily spot inspection methods be clearly defined. One of the methods when this type of protective device malfunctions is the generation of a warning alarm.

13) Malfunctions of parts of mechanisms

Appropriate considerations must be directed at the wearing properties which should be incorporated into the design of certain parts such that malfunctions in the form of vibration of the bearing of the accelerator conversion device, trouble in the link mechanism, or improper operation of the return springs do not appear very early in the game.

14) Malfunctions due to electric waves

Design studies must be conducted for the prevention of faulty operation of control operations or dangerous control states of the control device because of electric waves transmitted by gasoline automobile ignition systems, transistors, or street car power lines.

3.5.5 Malfunctions, abnormalities of battery

1) Overdischarge

When the voltage of the main battery is down as the result of overdischarge, the speed may not increase or acceleration and hill climbing power may suffer. When the auxiliary battery voltage is low as the result of overdischarge, it is possible for a situation to arise in which the control device is incapable of speed control, and the vehicle may not run.

Both the main battery and auxiliary battery should be well charged before use. The residual charge gage must accurately display the .esidual charge value regardless of the running state of the automobile, state of charge, or lowered battery life. An erroneous display can invite the possibility of the vehicle stalling on a trip.

The charging device which charges the auxiliary battery when the vehicle is running must be designed so that there is no overdischarge even at maximum load such as at night and in rain. When the control voltage is tapped off the auxiliary battery, measures are necessary to prevent the auxiliary battery being overdischarged before the main battery and cause a state of running incapability.

2) Abnormal loss of battery solution

When the electrolyte solution level in the battery drops to a low level, the voltage drops to give rise to a situation similar to overdischarge. There is need for construction which detects the electrolyte solution level to see that it has not gone down below the permissible level and which facilitates the replenishment of liquid when the limit has been exceeded.

3) Leakage of electrolyte solution

When electrolyte solution leaks as the result of overreplenishment of liquid or cracks formed in the battery case, deterioration of insulation, corrosion, or running abnormalities may occur.

A ready means of detecting when the electrolyte solution level is not above the specified level is necessary, and it is very desirable that an automatic water replenishment device which does not overfill and operates in very reliable manner be installed. The battery case must be made with sufficient strength so that no cracks are formed by vibrations. At the same time, there

is need for devising supports to prevent the application of impact forces on the battery case as a result of vibrations or covers to protect against rocks which may be flung at the case.

4) Internal malfunctions of battery

Running abnormalities are also generated by various abnormalities and malfunctions within the internal sections of the battery, and there is need for design of batteries which will not suffer internal abnormalities or malfunctions as the result of vibrations, the usual type of quick charge, or quick discharge and will operate for a long time safely.

3.5.6 Charger

1) Charging failure

The charger must have adequate reliability so that charging failures as the result of malfunctions do not occur. At the same time, should malfunctions occur, the design should allow ready inspection and repair.

2) Overcharging

Overcharging not only lowers battery life but also generates hydrogen and oxygen to create a dangerous situation while lowering the electrolyte solution level. The charge must be provided with protective capability against overcharging and must be constructed to enable ready point inspection and repair.

3) Vehcile moving with charging plug connected

Should the vehicle start moving while the vehicle is connected to the charger to charge the battery, a dangerous situation is created, and it is desirable for some safety device be installed to avoid such an incident.

3.5.7 Accessory equipment

1) Malfunction of auxiliary battery charger

The DC-DC converter for charging the auxiliary battery with the main battery and a charging generator must be designed with good reliability against charging failure or overcharging failure.

When some malfunction prevents charging, provisions must have been made so that there is an indication of this malfunction such as the lighting of a charging warning lamp so that repair can be quickly made. There is also need for means to protect the charger so that surge voltages created by shorting and opening with load do not cause burns or malfunctions.

2) Malfunctions, abnormalities of cooling device

When there is a malfunction in the cooling device for the motor or control device, there is abnormal temperature rise, and normal operation may not be possible.

The motor used in cooling device must be selected for considerable wear. If the motor uses brushes, brush exchange must be made very simple through the proper construction. There is also need for a structure in which dirt or extraneous matter can enter the cooling pathway with great difficulty.

Harmful Incidents or Adverse Effects on Passenger or Third Party

3.6.1 General exposition

An automobile because of its nature and other factors always has the potential of imparting some harmful effect on its passengers or third parties.

Here we will leave out items unique to automobiles and discuss problem areas of adverse effects or harmful incidents to passengers or third parties as the result of electric automobile handling and use along with countermeasures.

3.6.2 Electric wave interferences

1) Problem areas

There is need to vary the electrical energy supplied from the battery to the motor in order to control the speed of an electric automobile. As a result of this change in amount of energy supplied, there is loss in energy of which a fraction assumes the nature of electromagnetic energy from the battery, electric cables, reactor, and motor to be transmitted outside the automobile as electric wave interferences. When this interference was tested on an automobile, it was found that this interference could be disregarded at a distance 1 m or more from the vehicle as far as a car radio was concerned as a result of which it may be said that any effect on a third party is very small. On the other hand there seems to be some interference to the car radio on the electric automobile itself.

2) Countermeasures

a) For cables which may serve as transmission antenna

° Reduce distance between battery and control device
° Use twisted wire cables
° Place electromagnetic shields such as steel plate

b) For control device

° Use of control mode in which intermittent current flows with difficulty (such as use of field magnet control mode)

° Development of parts and circuits with little generation of electric wave interference

c) With regard to car borne electronic equipment

° Development of mechanisms difficulty affected by electric wave interference

3) Future subjects of study

a) There are many unknown areas on the effects an electric automobile may have as the result of the coming developments in electronics. For example, what effects there will be in the pacemakers used by heart patients which use very weak signals when they ride electric automobiles on microcomputers placed aboard electric automobiles are not known for the most part, and there is need for future research along this line.

b) Should the thyrister type phase control charger become the main stream in the future in order to improve the charging efficiency of ground based charging systems, the need for measures to prevent electric wave interference seems to be in order.

3.6.3 Noise

1) Legal aspects

There are at present the following laws which apply to automobile noise

- ° Permissible limit for automobile noise (maintenance standards for vehicles on highways)
- ° Permissible standards for automobile noise (Environmental Agency Notification of September 1975)
- ° Future permissible standards for automobile noise (Central Pollution Countermeasures Council as of 15 June 1976)
- ° Environmental noise standards for areas which front highways (Cabinet decision of 25 May 1971)

2) Problem areas

An electric automobile is very quiet compared to an internal combustion engine automobile, its effect on a third party is small, and this factor is thought to be one of the major merits of the introduction of electric automobiles. On the other hand, the ear affecting noise from electromagnetic forces (electromagnetic noise) may have severe psychological effect on a passenger within the vehicle which is a considerable problem.

There may be need for more research to remove this problem.

3) Electromagnetic noise

a) Causes

Battery currents in the chopper circuit and motor currents create electromagnetic forces which generate groaning sound from the motor, battery, reactor, and electric cables. In addition, cables close to steel bodies create groaning sounds again from the same electromagnetic forces and emit characteristic "bee" sound. This sound is particularly loud when accelerating, and some people find the sound uncomfortable.

b) Countermeasures

The measures listed in 3.6.2 2 can be applied here also, and the cables should be separated from the body wherever possible.

4) Other problems

There is also the groaning sound of the transformer that is part of the charger when the electric automobile is being charged. This may prove to be a hindrance to sleep should the automobile be charged at night. The use of a charger with its transformer provided with a cut core or the use of a switching mode which removes audible frequencies should be devised and introduced.

Special considerations are necessary near patients.

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PRC ORIENTAL MEDICINE RESEARCH--Kanazawa, 20 May--The Oriental Medicine Clinical Institute announced Tuesday that it had signed a memorandum last Sunday with China's national counterpart in Beijing on joint research into herb-centered Chinese medicine. The Japanese Institute of Researchers of Chinese Medicine said the agreement had come after talks with a delegation from the Chinese medical world which recently visited here. Under the agreement, first of the kind in Japan, Japanese and Chinese experts will concentrate research work on themes to be specified after the institute's mission visits its Chinese partner--the Chinese Medicine Institute--in Beijing this September. The institute expects the combination of Japan's advanced electronics technology with Chinese medicine to lead to new medical discoveries. It plans to seek cooperation in the joint research from related institutes at universities throughout the country. The Chinese delegation, which arrived in Japan last Thursday, is now visiting Chinese medicine fairs underway throughout the country. [OW201401 Tokyo KYODO in English 1137 GMT 20 May 80]

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